http://waterheatertimer.org/How-to-change-120-Volt-subpanel-to-240-Volt-subpanel.html

SIEMENS

Dry Type Transformers

Selection and Application Guide

What is a Transformer?

Transformers are completely static electrical devices which convert alternating current from one voltage level to another.

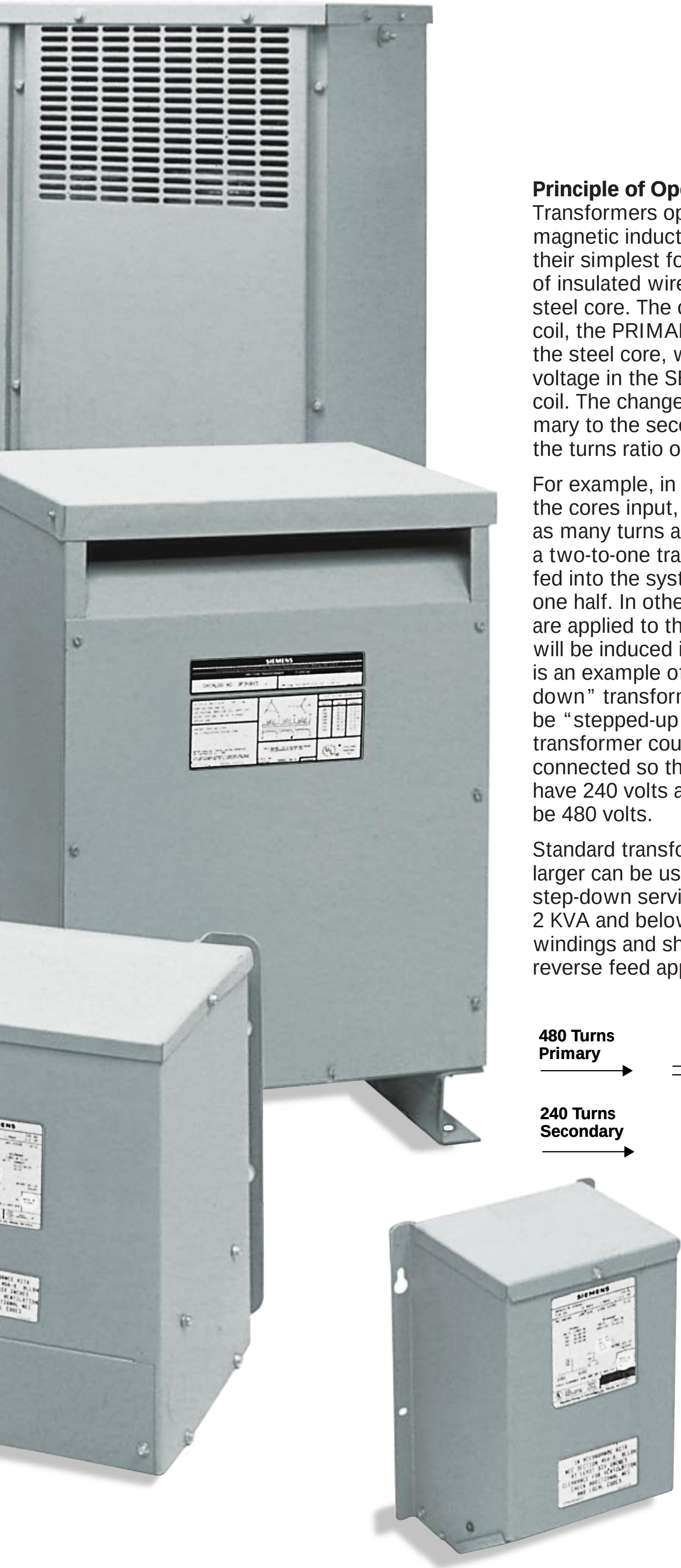
General purpose transformers are rated 600 volts and below for supplying appliance, lighting, and power loads from electrical distribution systems. Standard distribution voltages are 600, 480, and 240 volts; standard load voltages are 480, 240, and 120 volts.

The transformer is used to match the voltage supply to the electrical load. They can increase (step-up) or decrease (step-down) voltages. Since no vaults are required for installation, dry type transformers can be located right at the load to provide correct voltage for the application. This eliminates the need for long, costly, low voltage feeders.

Siemens general purpose transformers meet applicable NEMA, ANSI, UL, and IEEE standards.
ANSI C89.2/NEMA ST 20
ANSI C57.12.91
ANSI C57.96
UL 506
UL 1561

Contents

What does a Transformer do?

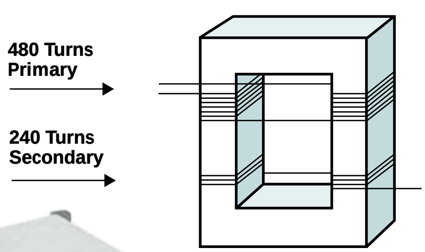


Principle of Operation

Transformers operate on the principle of magnetic induction. They consist, in their simplest form, of two or more coils of insulated wire wound on laminated steel core. The current supplied to one coil, the PRIMARY or input, magnetizes the steel core, which in turn induces a voltage in the SECONDARY or output coil. The change of voltage from the primary to the secondary is proportional to the turns ratio of the two coils.

For example, in the figure shown below, the cores input, or primary leg has twice as many turns as the secondary. This is a two-to-one transformer...any voltage fed into the system will be reduced by one half. In other words, if 480 volts are applied to the primary, 240 volts will be induced in the secondary. This is an example of a two winding "step-down" transformer. If the voltage is to be "stepped-up" or increased, the same transformer could be turned around and connected so that the input side would have 240 volts and the output would be 480 volts.

Standard transformers rated 3 KVA and larger can be used for either step-up or step-down service. Transformers rated 2 KVA and below have compensated windings and should not be used in reverse feed applications.

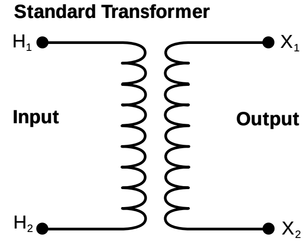


Autotransformers

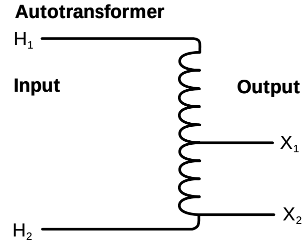
Standard transformers are referred to as insulating transformers, or isolation transformers, because the primary and secondary windings are separated by insulation. There is no electrical connection between the windings; the voltage is magnetically induced between the primary and secondary. As such, two-winding transformers isolate the load circuit from the supply circuit.

Autotransformers are specially designed transformers consisting of one continuous winding. The primary and secondary are electrically connected. The required secondary voltage is obtained by designing a tap at the appropriate turn location. Autotransformers can be used in three phase or single phase applications to perform the same function as two-winding transformers, with the exception of isolating two circuits. Since they are physically connected internally, autotransformers do not provide circuit isolation and in some cases, local codes may restrict their use.

Standard Transformer



Autotransformer



Overview, Selection and Application

Insulation Systems

There are four types of insulation systems commonly used in dry type transformers. Each is made of materials that will withstand a certain temperature without shortening the life of the transformer. This means that regardless of the insulation system used, transformers operating at their rated temperature rise will have essentially the same design life. Each insulation system will withstand the following average temperature rise over a 40°C ambient as defined by ANSI (American National Standards Institute) and NEMA (National Electrical Manufacturers Association).

Insulation System Classification			
Maximum Ambient	**+ Winding Rise**	**+ Hot Spot**	**= Temp. Class**
40°C	55°C	10°C	105°C
40°C	80°C	30°C	150°C
40°C	115°C	30°C	185°C
40°C	150°C	30°C	220°C

Temperature Rise

The temperature rise for transformers is the average temperature rise of the aluminum or copper conductor inside the coil windings. The temperature rise does not apply to the outside surface, the core, or any part of the transformer–only the coil. The temperature rise of the coil is set by the designer and must be compatible with the limit of the insulation system. That is, when a 220°C rise insulation system is used, the rise of the coil must not exceed 150°C. Surface temperatures on transformers are established by Underwriter's Laboratories (UL).

°C - °F	°C - °F
0° - 32°	100° - 212°
10° - 50°	105° - 221°
30° - 86°	115° - 239°
40° - 104°	150° - 302°
55° - 131°	185° - 365°
80° - 176°	220° - 428°
90° - 194°	

Low Temperature Rise

Transformers rated 15 KVA and above using 220°C insulation can be designed for 115°C or 80°C winding temperature rise as an optional feature. Reducing the temperature from 150°C rise provides several benefits:

- Reduced losses, lower operating costs, higher efficiency.
- Additional capacity for emergency overloads.
- Longer expected transformer life.
- Conserves electrical power, less heat generated, saves energy.

Rating of Insulation	Design Temp. Rise	Operating Temperature	Overload Capability
220°C	80°C	150°C	30%
220°C	115°C	185°C	15%
220°C	150°C	220°C	0%

When operated at rated KVA and temperature rise, losses for 115°C rise are about 10-20% less, and 80°C rise are about 20-35% less than transformers with 150°C rise/220°C insulation system.

80°C Rise

40°C Maximum Ambient	80°C Winding Rise	30°C Hot Spot Allowance	**70°C Reserve (30%)**
	110°C Hot Spot Rise (80°C + 30°C)		

150°C 220°C

115°C Rise

40°C Maximum Ambient	115°C Winding Rise	30°C Hot Spot Allowance	**35°C Reserve (15%)**
	145°C Hot Spot Rise (115°C + 30°C)		

185°C 220°C

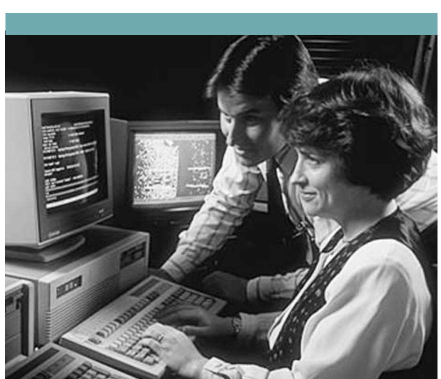
150°C Rise

40°C Maximum Ambient	150°C Winding Rise	30°C Hot Spot Allowance
	180°C Hot Spot Rise	

220°C

Rating

The transformer rating includes its KVA, phase, frequency, voltages, taps, connections, and temperature rise. This information is shown on the nameplate.



Overload Capability

Per ANSI loading guides, the amount, frequency, and duration of loading cycles determine a transformer's life. Transformers can deliver short-term overloads without being damaged if the overload period is preceded and followed by reduced loads. (Reference ANSI C57.96).

Ambient Temperature and Altitude

The ambient air temperature should not exceed 30°C average, or 40°C maximum over a 24-hour period, and the altitude should not exceed 3300 feet above sea level for normal operation.

Basic Impulse Levels

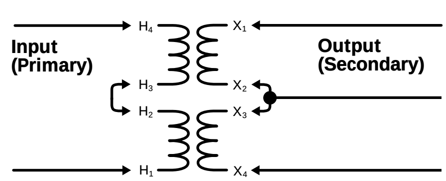
Basic impulse level (BIL, or kv-BIL) is the ability of the transformer insulation to withstand high voltage surges due to switching or lightning. Dry type 600 volt class transformers are rated 10 kv-BIL per industry standards.

Series-Multiple Connections

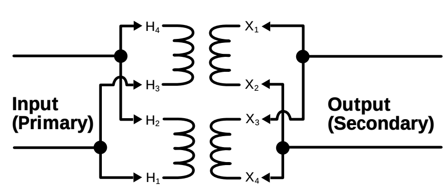
Transformers with two identical voltages (e.g. 120/240 or 120 x 240) may be connected either in series or in parallel per the connection diagrams. Connected in series, the transformer will provide the higher voltage (240 volts); connected in parallel, the lower voltage (120 volts) is obtained.

If the dual voltage is separated by an "X" (120 x 240), the transformer can be connected only for 120 volts or 240 volts. But, if it is separated by a "slash" (120/240), an additional connection is possible since the mid-point becomes available for 240/120 3-wire operation.

Series Connection (typical)



Multiple (Parallel) Connection (typical)



Voltage Termination

Both high voltage and low voltage windings are terminated in the transformer wiring compartment. The high voltage terminations are identified in accordance with NEMA standards as H1, H2, H3, the low voltage leads as X1, X2, X3 and the neutral as X0. The connection diagram on the transformer nameplate shows the proper connections for series or multiple connections and tap settings.

Voltage Changing Taps

Taps are frequently added on the primary winding to change the turns ratio and compensate for high or low line voltages. The number of taps and the tap ratio depend on the KVA size and the design volts per turn ratio. Standard taps are two 5% below normal on most smaller transformers to provide a 10% range of tap voltage adjustment. Most larger transformers have six taps - four 2-½% below normal and two 2-½% above normal for a 15% range of tap voltage adjustment. For some ratings, the actual number of taps and the tap ratio may vary based on the volts per turn ratio required for the design.

Sound Levels

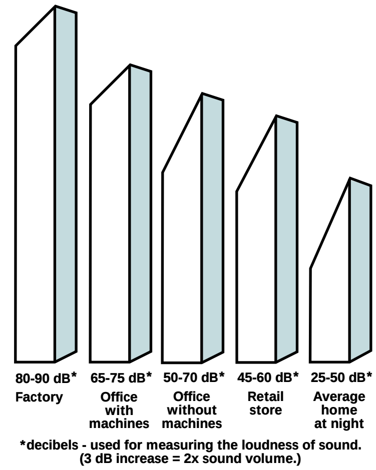
All transformers that are energized will produce an audible noise that sounds like a “hum.” ANSI and NEMA standards for average sound levels are shown below. Transformers can be custom designed for sound levels below standard when specified.

KVA	Average dB Sound Level ①
0 - 9	40
10 - 50	45
51 - 150	50
151 - 300	55
301 - 500	60
501 - 700	62
701 - 1000	64

① ANSI C89.2/NEMA ST20 (150°C RISE K-1)

Reducing Noise Levels

The sound level of background music, a typical classroom, or conversation at 3 feet is about 60 dB. The ambient sound level, or background noise can reach 90 dB in typical industrial locations. Generally, sound levels above 70dB are considered annoying and 100 dB very loud. To achieve a “quiet” transformer installation, use the following tips:



Average ambient sound level of typical locations

1. Install the transformer so that vibrations are not transmitted to the structural parts of the building. Mounting should be on a solid wall, floor, or other structure with solid mass. Mounts must be isolated and properly loaded, avoiding direct contact with other metal structures.

2. Isolate the transformer by using flexible couplings and conductors to help prevent vibrations being transmitted to other equipment. Make sure shipping braces and hold-down bolts are loosened or removed as specified by the manufacturer’s installation manual. Ventilated transformers should “float” on vibration dampening pads located between the enclosure and the core and coil assembly.

3. Locate the transformer where sound is not significantly increased by sound reflection. When transformers are mounted in a corner or near the ceiling, the adjacent surfaces act as a megaphone. Halls or small and narrow areas with short distance between multiple reflective areas will also amplify sound.

4. Transformer noise can be reduced in a closet or behind a wall if the wall has no openings and is not subject to vibrations from the transformer. Make sure the area has proper air ventilation. Curtains, screens, and other ceiling or wall sound treatments are generally not effective barriers to transformer noise.

5. Locate the transformer away from areas where noise is undesirable. Improper location and installation can increase the noise level 10 dB or more and cause complaints about transformer noise.

Taps		Rated Line Voltage					
		120	208	240	277	480	600
2 - 5% FCBN	-5%	114	198	228	263	456	570
Figure A	-10%	108	187	216	249	432	540
	+5%	126	218	252	291	504	630
2 - 2.5% FCAN	+2.5%	123	213	246	284	492	615
4 - 2.5% FCBN	-2.5%	117	203	234	270	468	585
Figure B	-5%	114	198	228	263	456	570
	-7.5%	111	192	222	256	444	555
	-10%	108	187	216	249	432	540

Figure A (typical)

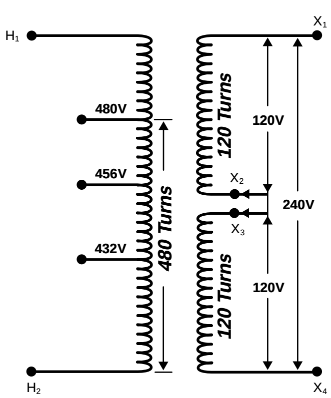
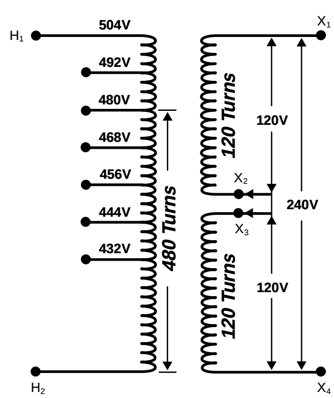


Figure B (typical)



Selection and Application

Selection Factors
The most important thing to remember when selecting a transformer is to choose a unit that matches supply and load conditions. You must first determine:

Line (available)	Load (needed)
Voltage Frequency Phase	KVA Voltage Frequency Phase

Selecting Transformer KVA Rating
You will usually know your load requirements. If not, maximum load current multiplied by the load voltage gives volt-amp capacity for single phase applications. For three phase applications, multiply load current times load voltage times 1.732. The transformer must have this minimum nameplate capacity in volt-amps (or KVA if volt-amps has been divided by 1000).

Single phase:

KVA = (FLA x Volts) ÷ 1000

Three phase:

KVA = (FLA x Volts x 1.732) ÷ 1000

Usually, some provision for future increase in load should be made when selecting the transformer. For example, if maximum load current is 50 amps and load voltage is 120, single phase, the requirement is 6,000 VA or 6 KVA. The next largest standard single phase unit is 7-½ KVA, which allows for future load expansion. If load requirements are given in watts, the power factor of the load must be considered. Divide the watts by the power factor to determine VA capacity:

$$\textbf{VA capacity} = \frac{\text{Watts}}{\text{Power Factor}}$$

$$\textbf{KVA capacity} = \frac{\text{KW}}{\text{Power Factor}}$$

When motors are installed in the circuit, the current required to deliver rated motor horsepower dictates the minimum transformer KVA required.

Selecting Voltage Ratings
Next select the proper line and load voltages. In most cases, you will already know the power supply and load ratings. In single phase circuits, the transformer primary must match the line voltage. For example, if the line voltage is rated single phase, 60 Hz 480 volts, a transformer rated 240 x 480 volts primary, or 480 volts primary, with taps is suitable. The same principle applies to load voltage.

Frequency and Phase
The transformer cannot change the frequency of the supply. Therefore, it the load is rated 60 Hz, the supply must also be rated 60 Hz. Transformers rated to carry 60 Hz should not be used on other frequencies. Transformers rated 50 Hz can be used for either 50 or 60 Hz.

If the load is three phase, both the supply and transformer must be three phase. If the load is single phase, the supply can be either single or three phase, but the transformer will be single phase.

Special Applications
If the transformer is to be installed outdoors, it must be suitable for outdoor application. Be on the alert for high ambient temperatures (above 40° C), high altitude conditions (above 3300 feet), and high humidity or salt-spray conditions. Refer to NEMA ST20 and ANSI C57.96 for high ambient or high altitude applications. Special transformers are normally required for such applications.

Transformers can be operated step-down or step-up provided the rated nameplate KVA is 3 KVA or greater. Below 3 KVA, the transformers usually have compensated windings to provide rated voltage at rated load.

If these transformers are reverse-connected, the load voltage will not match the nameplate value. Depending on KVA size, the actual load voltage could be up to 15 per cent lower than expected.

When using transformers in reverse (step-up), remember that the normal primary taps will now be on the secondary. Also, with three phase delta wye models, the neutral of the 4-wire secondary winding will now be on the primary side. The neutral (XO) is not needed in this application. It should be insulated and not connected to the input source neutral if one exists. The transformer will now be the equivalent of a delta-delta connection.

Catalog Coding System

1	D	1	Y	167	K4	F	ES	C	LN3	W	DS

Basic Rating Information

- PHASE
- PRIMARY VOLTAGE
- SECONDARY VOLTAGE
- TAPS
- KVA

Optional Modifications ①

- K-FACTOR RATED
  - 50% Non-Linear Load (K4)
  - 100% Non-Linear Load (K13)
  - 125% Non-Linear Load (K20)
  - 150% Non-Linear Load (K30)
- LOW TEMPERATURE RISE
  - 80°C (B)
  - 115°C (F)
- ELECTROSTATIC SHIELD (ES)
- COPPER WOUND (C)
- LOW NOISE
  - (SPECIFY LN3 LN5, ETC.)
- WALL MOUNTING BRACKETS (W)
- DRIP SHIELDS (DS)

▲ Add suffix codes if optional modifications required

① Suffix code for optional information indicated in parentheses. Other optional modifications must be specified.

Drive Transformer Catalog Coding - See Page 15.

Phase	
1 Phase	1
3 Phase	3

Primary			
240 x 120	A	277	E
208	B	480	F
240	C	600	G
480 x 240	D		

Secondary	
120/240	1
240/120 LT	1
240	2
208Y/120	3
480	4
480Y/277	5

Optional Modifications

- K4 - 50% Non-Linear Load
- K13 - 100% Non-Linear Load
- K20 - 125% Non-Linear Load
- K30 - 150% Non-Linear Load
- B - 80°C Rise
- F - 115°C Rise
- ES - Electrostatic Shield
- C - Copper Windings
- LN( ) - Low Noise (specify dB level)
- TE - Totally Enclosed Non-Ventilated
- W - Wall Brackets
- DS - Drip Shield (NEMA 3R)

Taps ①

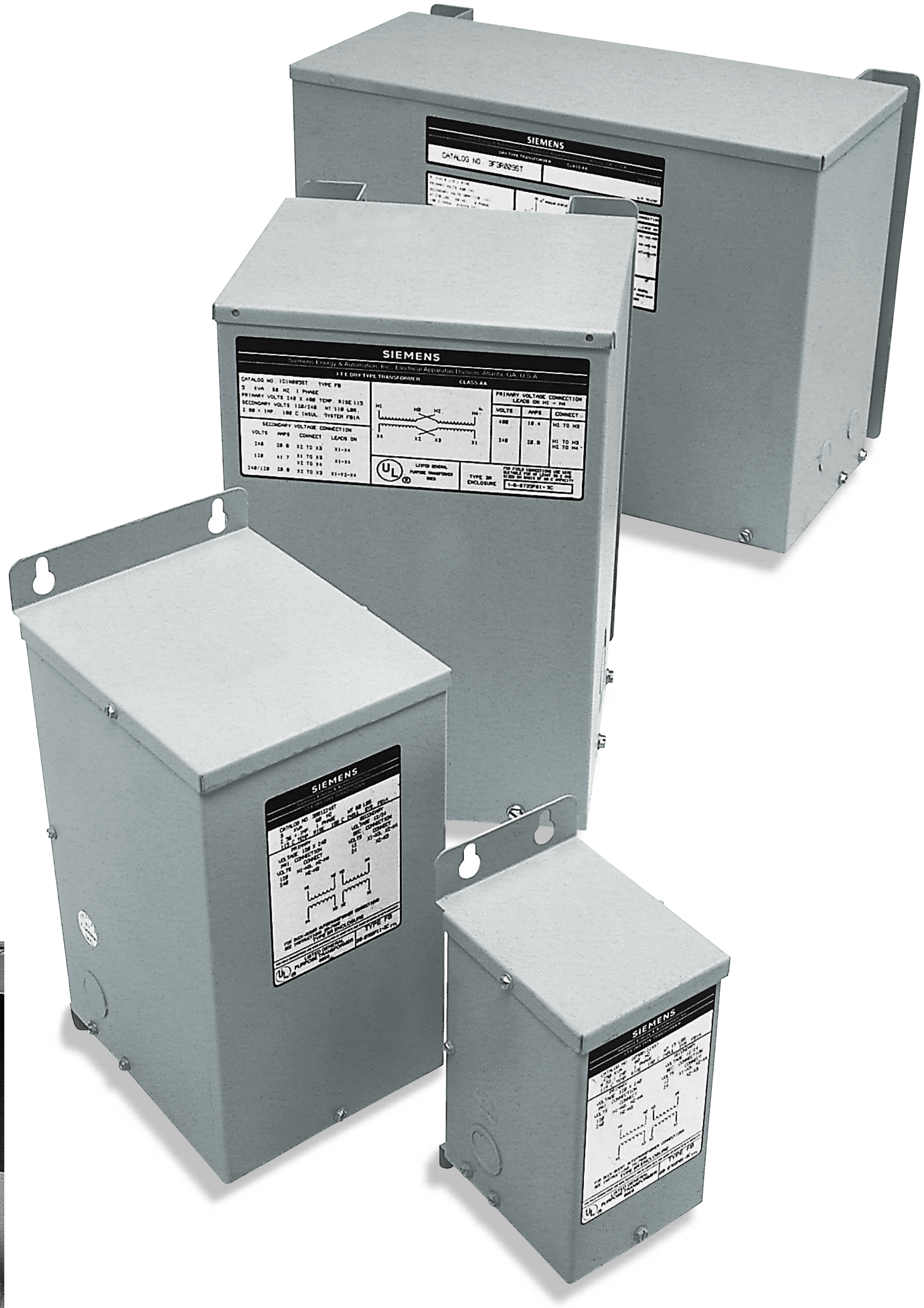
Description	Catalog Code
None	N
2 - 5 % FCBN	R
2 - 5% (1 FCAN, 1 FCBN)	S
4 - 2.5% (2 FCAN, 2 FCBN)	T
2 - 2.5% FCBN	U
4 - 2.5% FCBN	X
6 - 2.5% (2 FCAN, 4 FCBN)	Y
4 - 3.1% (2 FCAN, 2 FCBN)	J
2 - 3.5% (1 FCAN, 1 FCBN)	K
3 - 5% (1 FCAN, 2 FCBN)	M

KVA

KVA	Catalog Code	KVA	Catalog Code	KVA	Catalog Code	KVA	Catalog Code
0.25	205	5	005	37.5	037	167	167
0.50	505	7.5	007	45	045	225	225
0.75	705	9	009	50	050	300	300
1	001	10	010	75	075	500	500
1.5	105	15	015	100	100	750	750
2	002	25	025	112.5	112	1000	1000
3	003	30	030	150	150		

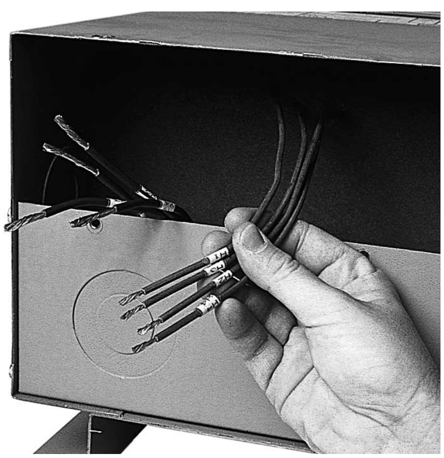
① Actual taps may vary based on volts/turn ratio.

Encapsulated Transformers
.050 - 3.0 KVA Single Phase
3.0 - 15 KVA Three Phase



Features

- UL listed designs which comply with applicable ANSI, NEMA, IEEE standards.
- Totally enclosed, non-ventilated, heavy gauge steel enclosure.
- Core and coil completely embedded within a resin compound for quiet, low temperature operation.
- Encapsulation seals out moisture and air.
- UL listed indoor/outdoor enclosure features integral wall mounting brackets.
- Rugged design resists weather, dust, and corrosion.
- Efficient, compact, lightweight, easy to install.
- Flexible wiring leads that terminate within the bottom wiring compartment.
- Large wiring compartment on the bottom with convenient knockouts.
- High quality non-aging electrical grade core steel.
- Precision wound coils.



Wiring compartment for encapsulated transformer

Ventilated Transformers
15 - 167 KVA Single Phase
15 - 1000 KVA Three Phase

Features

- UL listed designs which comply with applicable ANSI, NEMA, and IEEE standards.
- Designed for indoor installation: enclosures suitable for outdoor locations available as an option.
- Core and coils are designed with UL listed high-temperature materials rated for 220°C; standard units feature 150°C winding temperature rise.
- Optional low temperature rise of 115°C or 80°C winding temperature rise for increased efficiency and additional overload capability.
- Rugged 12 gauge sheet steel enclosure with removable panels for access to the internal wiring area.
- Neoprene noise dampening pads isolate the core and coil from the enclosure.
- Optional drip shields and wall brackets available on most ratings.
- High quality, non-aging electrical grade core steel.
- Precision wound coils.
- Totally enclosed Non-Ventilated designs available as an optional feature on most ratings.

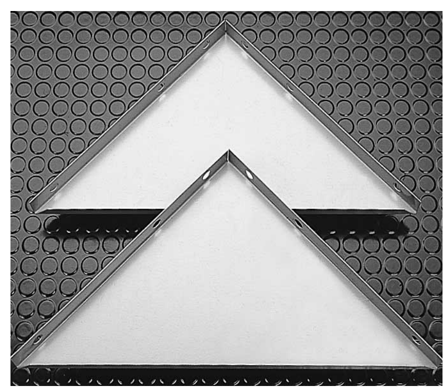
Optional Accessories

Wall Mounting Brackets ③	
1 Phase 3 Phase	15-50 KVA 15-50 KVA

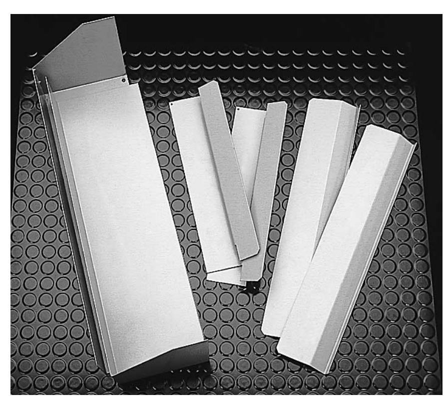
Drip Shield Kits ①	
1 Phase 3 Phase	15-167 KVA 15-225 KVA ②

① NEMA 3R outdoor rated transformer with installation of optional drip shield kit.
② Contact sales office for kits used on larger ratings.
③ For units having standard features.

Wiring compartment for ventilated transformer



Wall Mounting Brackets



Drip Shield Kits

Steps To Select Single Phase and Three Phase Transformers

Single Phase Transformers

1. Determine the electrical supply.
   a) Check the primary source (input) voltage available.
   b) Check the frequency in hertz, or cycles per second. The frequency of the primary line supply, the transformer, and the load equipment must be the same.
2. Determine the electrical load.
   a) The secondary voltage or load (output) voltage required.
   b) Load ampere, or KVA capacity required by the load.
   c) Verify the load is designed to operate on the same phase and frequency that is available.
   d) Select a transformer with a KVA capacity equal to or greater then the required load.
   e) Use charts, or calculate the load as follows:

$$\text{1 Phase KVA} = \frac{\text{Volts x Amps}}{1000}$$

$$\text{Load Amps} = \frac{\text{1 Phase KVA x 1000}}{\text{Volts}}$$

   f) Determine taps to compensate for line voltage variation and temperature rise requirements.

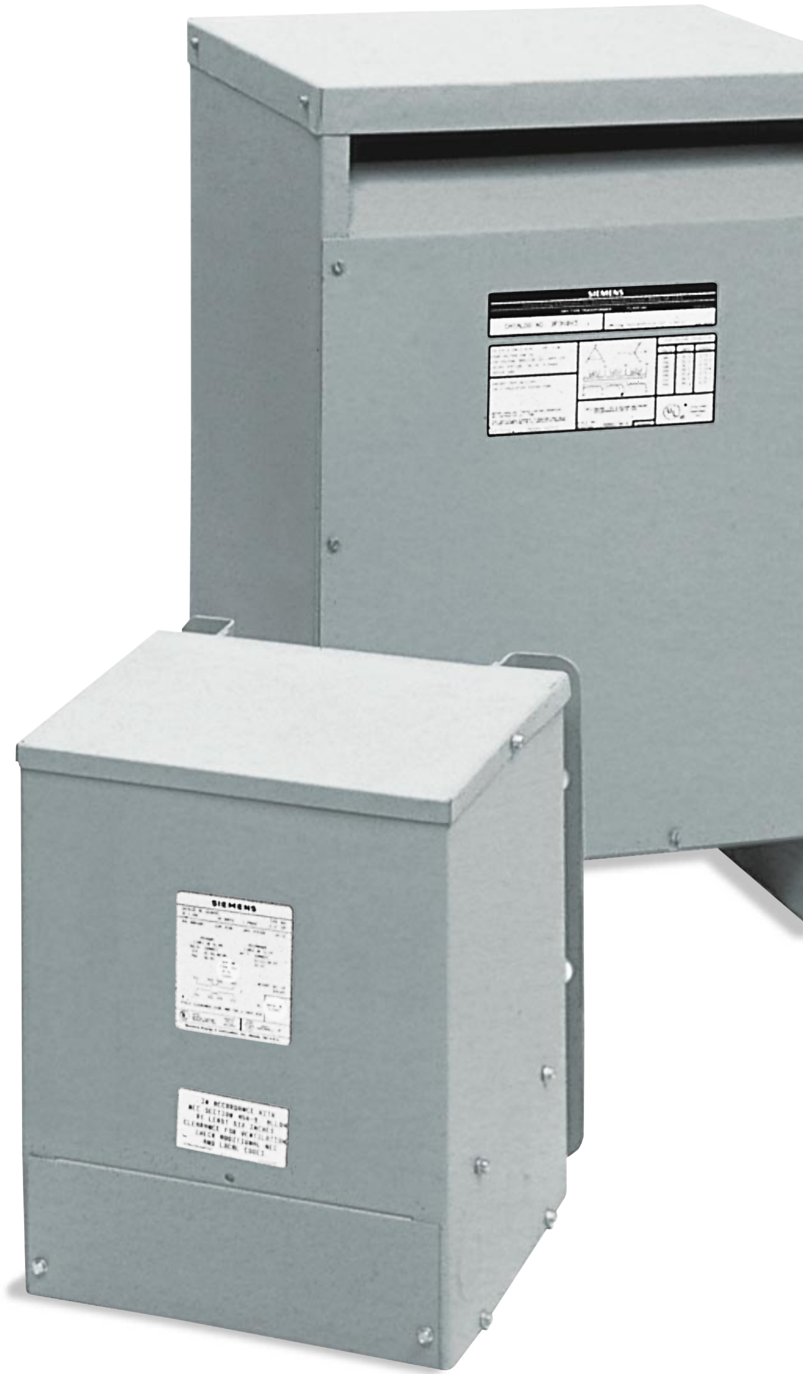
Single Phase Full Load Amperes						
KVA	120V	208V	240V	277V	480V	600V
.25	2.0	1.2	1.0	0.9	0.5	0.4
.50	4.2	2.4	2.1	1.8	1.0	0.8
.75	6.3	3.6	3.1	2.7	1.6	1.3
1	8.3	4.8	4.2	3.6	2.1	1.7
1.5	12.5	7.2	6.2	5.4	3.1	2.5
2	16.7	9.6	8.3	7.2	4.2	3.3
3	25	14.4	12.5	10.8	6.2	5
5	41	24	20.8	18.0	10.4	8.3
7.5	62	36	31	27	15.6	12.5
10	83	48	41	36	20.8	16.7
15	125	72	62	54	31	25
25	206	120	104	90	52	41
37.5	312	180	156	135	76	62
50	416	240	208	180	104	83
75	625	340	312	270	156	125
100	833	480	416	361	208	166
167	1391	803	695	603	347	278
250	2063	1202	1041	903	520	416
333	2775	1601	1387	1202	695	555
500	4167	2404	2063	1805	1042	833

AC Motor Full Load Running Current and Recommended Transformer Ratings ①																
Horsepower	110-120V				220-240V②				440-480V				550-600V			
	Single Phase		Three Phase		Single Phase		Three Phase		Single Phase		Three Phase		Single Phase		Three Phase	
	Amps	KVA	Amps	KVA	Amps	KVA	Amps	KVA	Amps	KVA	Amps	KVA	Amps	KVA	Amps	KVA
½	9.8	1.5	4.0	3	4.9	1.5	2.0	3	2.5	1.5	1.0	3	2.0	1.5	0.8	3
¾	13.8	2.0	5.6	3	6.9	2.0	2.8	3	3.5	2.0	1.4	3	2.8	2.0	1.1	3
1	16.0	3.0	7.2	3	8.0	3.0	3.6	3	4.0	3.0	1.8	3	3.2	3.0	1.4	3
1 ½	20.0	3.0	10.4	3	10.0	3.0	5.2	3	5.0	3.0	2.6	3	4.0	3.0	2.1	3
2	24.0	5.0	13.6	6	12.0	5.0	6.8	6	6.0	5.0	3.4	6	4.8	5.0	2.7	6
3	34.0	5.0	19.2	6	17.0	5.0	9.6	6	8.5	5.0	4.8	6	6.8	5.0	3.9	6
5	56.0	7.5	30.4	9	28.0	7.5	15.2	9	14.0	7.5	7.6	9	11.2	7.5	6.1	9
7 ½	80.0	15	44.0	15	40.0	15	22.0	15	21.0	15	11.0	15	16.0	15	9.0	15
10	100.0	15	56.0	15	50.0	15	28.0	15	26.0	15	14.0	15	20.0	15	11.0	15
15	135.0	25	84.0	30	68.0	25	42.0	30	34.0	25	21.0	30	27.0	25	17.0	30
20	—	—	108.0	30	88.0	25	5.0	30	44.0	25	27.0	30	35.0	25	22.0	30
25	—	—	136.0	45	110.0	37.5	68.0	45	55.0	37.5	34.0	45	44.0	37.5	27.0	45
30	—	—	160.0	45	136.0	37.5	80.0	45	68.0	37.5	40.0	45	54.0	37.5	32.0	45
40	—	—	208.0	75	176.0	50	104.0	75	88.0	50	52.0	75	70.0	50	41.0	75
50	—	—	260.0	75	216.0	75	130.0	75	108.0	75	65.0	75	86.0	75	52.0	75
60	—	—	—	—	—	—	154.0	75	—	—	77.0	75	—	—	62.0	75
75	—	—	—	—	—	—	192.0	112.5	—	—	96.0	112.5	—	—	77.0	112.5
100	—	—	—	—	—	—	248.0	112.5	—	—	124.0	112.5	—	—	99.0	112.5

① Recommended KVA rating shown in chart includes aluminum of 10% spare capacity for frequent motor starting.
② To obtain full-clad currents for 200 and 208 volt motors, increase corresponding 220-240 volt ratings by 15 and 10% respectively.

KVA	Catalog Number	Taps ①	Temperature Rise	Insulation
208 Volts Primary, 120/240 Volts Secondary				
3	1B 1N003	None	115°C	180°C
5	1B 1N005	None	115°C	180°C
7.5	1B 1N007	None	115°C	180°C
10	1B 1N010	None	115°C	180°C
15	1B 1N015	None	115°C	180°C
25	1B 1N025	None	115°C	180°C
277 Volts Primary, 120/240 Volts Secondary				
3	1E 1U003	2 - 2½% FCBN	115°C	180°C
5	1E 1U005	2 - 2½% FCBN	115°C	180°C
7.5	1E 1U007	2 - 2½% FCBN	115°C	180°C
10	1E 1U010	2 - 2½% FCBN	115°C	180°C
15	1E 1U015	2 - 2½% FCBN	115°C	180°C
25	1E 1U025	2 - 2½% FCBN	115°C	180°C
240 x 480 Volts Primary, 120/240 Volts Secondary				
.25	1D 1N205	None	115°C	180°C
.50	1D 1N505	None	115°C	180°C
.75	1D 1N705	None	115°C	180°C
1.0	1D 1N001	None	115°C	180°C
1.5	1D 1N105	None	115°C	180°C
2.0	1D 1N002	None	115°C	180°C
3.0	1D 1N003	None	115°C	180°C
5.0	1D 1N005	None	115°C	180°C
7.5	1D 1N007	None	115°C	180°C
10	1D 1N010	None	115°C	180°C
15	1D 1N015	None	115°C	180°C
25	1D 1Y025		150°C	220°C
37.5	1D 1Y037		150°C	220°C
50	1D 1Y050	2 - 2½% FCAN	150°C	220°C
75	1D 1Y075	4 - 2½% FCBN	150°C	220°C
100	1D 1Y100		150°C	220°C
167	1D 1Y167		150°C	220°C
480 Volts Primary, 120/240 Volts Secondary				
3	1F 1R003	2 - 5% FCBN	115°C	180°C
5	1F 1R005	2 - 5% FCBN	115°C	180°C
7.5	1F 1R007	2 - 5% FCBN	115°C	180°C
10	1F 1R010	2 - 5% FCBN	115°C	180°C
15	1F 1R015	2 - 5% FCBN	115°C	180°C
600 Volts Primary, 120/240 Volts Secondary				
3	1G 1R003	2 - 5% FCBN	115°C	180°C
5	1G 1R005	2 - 5% FCBN	115°C	180°C
7.5	1G 1R007	2 - 5% FCBN	115°C	180°C
10	1G 1R010	2 - 5% FCBN	115°C	180°C
15	1G 1R015	2 - 5% FCBN	115°C	180°C
25	1G 1U025	2 - 2½% FCBN	150°C	220°C
37.5	1G 1U037	2 - 2½% FCBN	150°C	220°C
50	1G 1U050	2 - 2½% FCBN	150°C	220°C
75	1G 1U075	2 - 2½% FCBN	150°C	220°C
100	1G 1U100	2 - 2½% FCBN	150°C	220°C
167	1G 1U167	2 - 2½% FCBN	150°C	220°C

① Actual taps may vary based on volts/turn ratio.



Three Phase Transformers

To select Three Phase transformers follow the same steps as Single Phase, except use 3 phase Amps/KVA chart or calculate the load as follows:

$$3\text{ Phase KVA} = \frac{\text{Volts x Amps x 1.732}}{1000}$$

$$\text{Load Amps} = \frac{\text{3 Phase KVA x 1000}}{\text{Volts x 1.732}}$$

KVA	Catalog Number	Taps ①	Temperature Rise	Insulation
208 Volts Primary, 208Y/120 Volts Secondary				
15	3B3Y015	2 - 5% FCBN	150°C	220°C
30	3B3Y030	2 - 5% FCBN	150°C	220°C
45	3B3Y045	2 - 5% FCBN	150°C	220°C
75	3B3Y075	2 - 5% FCBN	150°C	220°C
112.5	3B3Y112	2 - 5% FCBN	150°C	220°C
150	3B3Y150	2 - 5% FCBN	150°C	220°C
225	3B3S225	1 - 5% FCBN	150°C	220°C
300	3B3S300	1 - 5% FCBN	150°C	220°C
500	3B3S500	1 - 5% FCBN	150°C	220°C
208 Volts Primary, 480Y/277 Volts Secondary				
15	3B5R015	2 - 5% FCBN	150°C	220°C
30	3B5R030	2 - 5% FCBN	150°C	220°C
45	3B5R045	2 - 5% FCBN	150°C	220°C
75	3B5R075	2 - 5% FCBN	150°C	220°C
112.5	3B5R112	2 - 5% FCBN	150°C	220°C
150	3B5R150	2 - 5% FCBN	150°C	220°C
225	3B5S225	1 - 5% FCAN	150°C	220°C
300	3B5S300	1 - 5% FCAN	150°C	220°C
500	3B5S500		150°C	220°C
240 Volts Primary, 208Y/120 Volts Secondary				
15	3C3Y015		150°C	220°C
30	3C3Y030		150°C	220°C
45	3C3Y045	2 - 2½% FCAN	150°C	220°C
75	3C3Y075	4 - 2½% FCBN	150°C	220°C
112.5	3C3Y112		150°C	220°C
150	3C3Y150		150°C	220°C
225	3C3S225	1 - 5% FCAN	150°C	220°C
300	3C3S300	1 - 5% FCBN	150°C	220°C
500	3C3S500		150°C	220°C
240 Volts Primary, 480Y/277 Volts Secondary				
15	3C5Y015		150°C	220°C
30	3C5Y030		150°C	220°C
45	3C5Y045	2 - 2½% FCAN	150°C	220°C
75	3C5Y075	4 - 2½% FCBN	150°C	220°C
112.5	3C5Y112		150°C	220°C
150	3C5Y150		150°C	220°C
225	3C5S225	1 - 5% FCAN	150°C	220°C
300	3C5S300	1 - 5% FCBN	150°C	220°C
500	3C5S500		150°C	220°C
480 Volts Primary, 208Y/120 Volts Secondary				
3	3F3R003	2 - 5% FCBN	115°C	180°C
6	3F3R006	2 - 5% FCBN	115°C	180°C
9	3F3R009	2 - 5% FCBN	115°C	180°C
15	3F3R015	2 - 5% FCBN	115°C	180°C
15	3F3Y015		150°C	220°C
30	3F3Y030		150°C	220°C
37.5	3F3Y037		150°C	220°C
45	3F3Y045		150°C	220°C
75	3F3Y075		150°C	220°C
112.5	3F3Y112	2 - 2½% FCAN	150°C	220°C
150	3F3Y150	4 - 2½% FCAN	150°C	220°C
225	3F3Y225		150°C	220°C
300	3F3Y300		150°C	220°C
500	3F3Y500		150°C	220°C
750	3F3Y750		150°C	220°C
1000	3F3Y000		150°C	220°C

Three Phase Full Load Amperes

KVA	208V	240V	416V	480V	600V
3	8.3	7.2	4.16	3.6	2.9
6	16.6	14.4	8.32	7.2	5.8
9	25	21.6	12.4	10.8	8.6
15	41.7	36.1	20.8	18.0	14.4
30	83.4	72.3	41.6	36.1	28.9
45	124	108	62.4	54.2	43.4
50	139	120	69.4	60.1	48.1
75	208	180	104	90	72
112.5	312	270	156	135	108
150	416	360	208	180	144
225	624	541	312	270	216
300	832	721	416	360	288
500	1387	1202	693	601	481
750	2084	1806	1040	903	723
1000	2779	2408	1388	1204	963

KVA	Catalog Number	Taps ①	Temperature Rise	Insulation
480 Volts Primary, 240 Volts Secondary				
3	3F2R003	2 - 5% FCBN	115°C	180°C
6	3F2R006	2 - 5% FCBN	115°C	180°C
9	3F2R009	2 - 5% FCBN	115°C	180°C
15	3F2R015	2 - 5% FCBN	115°C	180°C
480 Volts Primary, 240 Volts Secondary with 120 Volt Lighting Tap ②				
15	3F1Y015		150°C	220°C
30	3F1Y030		150°C	220°C
45	3F1Y045		150°C	220°C
75	3F1Y075	2 - 2½% FCAN	150°C	220°C
112.5	3F1Y112	4 - 2½% FCBN	150°C	220°C
150	3F1Y150		150°C	220°C
225	3F1Y225		150°C	220°C
300	3F1Y300		150°C	220°C
500	3F1Y500		150°C	220°C
480 Volts Primary, 480/277 Volts Secondary				
15	3F5Y015		150°C	220°C
30	3F5Y030		150°C	220°C
45	3F5Y045		150°C	220°C
75	3F5Y075		150°C	220°C
112.5	3F5Y112	2 - 2½% FCAN	150°C	220°C
150	3F5Y150	4 - 2½% FCAN	150°C	220°C
225	3F5Y225		150°C	220°C
300	3F5Y300		150°C	220°C
500	3F5Y500		150°C	220°C
600 Volts Primary, 208Y/120 Volts Secondary				
3	3G3R003	2 - 5% FCBN	115°C	180°C
6	3G3R006	2 - 5% FCBN	115°C	180°C
9	3G3R009	2 - 5% FCBN	115°C	180°C
15	3G3R015	2 - 5% FCBN	115°C	180°C
30	3G3Y030		150°C	220°C
45	3G3Y045		150°C	220°C
75	3G3Y075		150°C	220°C
112.5	3G3Y112	2 - 2½% FCAN	150°C	220°C
150	3G3Y150	4 - 2½% FCBN	150°C	220°C
225	3G3Y225		150°C	220°C
300	3G3Y300		150°C	220°C
500	3G3Y500		150°C	220°C

① Actual taps may vary based on volts/turn ratio.
② Reduced capacity 1 phase tap - 5% rated KVA.

Electrostatic Shielded

Electrical noise and transients on power lines can be created by a number of different sources. Some examples are: lightning strikes, switching or motor loads or capacitors, and SCR circuits. Electrical noise can be classified as either “common” or “transverse” mode. Common-mode noise is the type which appears between the line conductor and ground, whereas transverse-mode noise appears between two line conductors. These types of noise have been around since electricity was first used. However, they were of little concern where traditional electro-mechanical devices were used.

But today, electronic components and systems are being used increasingly in many types of equipment destined for commercial and industrial installations. Electronic circuitry can be sensitive to transient noise and these transients have to be controlled.

Transient noise is usually measured in decibels (dB). Decibel is a unit of measurement, in this context, used to express the ratio between the input transient voltage and the output transient voltage.

Noise Attenuation (dB) =

$$20 \log_{10} \frac{V_{in}}{V_{out}}$$

The formula used in measurement of transient noise attenuation is logarithmic and hence a change of 40 dB to 60 dB is actually a ten fold reduction in electrical noise.

The following table outlines some common attenuating ratios and their decibel equivalents.

Voltage Ratio V in : V out	Transient Noise Attenuation (dB) ①
5:1	14
10:1	20
100:1	40
1,000:1	60
10,000:1	80
100,000:1	100
1,000,000:1	120

① Common mode.

Single Phase - Electrostatic Shielded ①

KVA	208 120/240	277 120/240	480 120/240	240x480 120/240	600 120/240
3	1B1N003ES	1E1R003ES	1F1R003ES	1D1N003ES	1G1R003ES
5	1B1N005ES	1E1R005ES	1F1R005ES	1D1N005ES	1G1R005ES
7.5	1B1N007ES	1E1R007ES	1F1R007ES	1D1N007ES	1G1R007ES
10	1B1N010ES	1E1R010ES	1F1R010ES	1D1N010ES	1G1R010ES
15	1B1N015ES	1E1R015ES	1F1R015ES	1D1N015ES	1G1R015ES
25				1D1Y025ES	1G1U025ES
37.5				1D1Y037ES	1G1U037ES
50				1D1Y050ES	1G1U050ES
75	—	—	—	1D1Y075ES	1G1U075ES
100				1D1Y100ES	1G1U100ES
167				1D1Y167ES	1G1U167ES

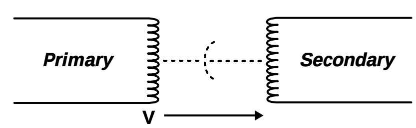
Three Phase - Electrostatic Shielded ①

KVA	208∆ 208Y/120	208∆ 480Y/277	480∆ 208Y/120	480∆ 240∆	480∆ 480Y/277
3			3F3R003ES	3F2R003ES	
6	—	—	3F3R006ES	3F2R006ES	—
9			3F3R009ES	3F2R009ES	
15	3B3Y015ES	3B5Y015ES	3F3Y015ES	3F1Y015ES	3F5Y015ES
30	3B3Y030ES	3B5Y030ES	3F3Y030ES	3F1Y030ES	3F5Y030ES
45	3B3Y045ES	3B5Y045ES	3F3Y045ES	3F1Y045ES	3F5Y045ES
75	3B3Y075ES	3B5Y075ES	3F3Y075ES	3F1Y075ES	3F5Y075ES
112.5	3B3Y112ES	3B5Y112ES	3F3Y112ES	3F1Y112ES	3F5Y112ES
150	3B3Y150ES	3B5Y150ES	3F3Y150ES	3F1Y150ES	3F5Y150ES
225		3B5S225ES	3F3Y225ES	3F1Y225ES	3F5Y225ES
300	—	3B5S300ES	3F3Y300ES	3F1Y300ES	3F5Y300ES
500		3B5S500ES	3F3Y500ES	3F1Y500ES	3F5Y500ES

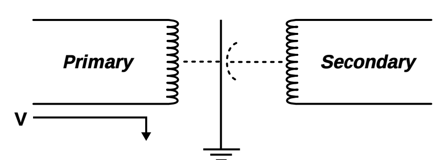
① Refer to page 5 for other optional modifications.

An optional feature for isolation transformers is to include an electrostatic shield between the primary and secondary windings. Shielded isolation transformers do not provide voltage regulation, but they do reduce electrical noise by attenuating spikes and transients to ground. The amount of transient noise attenuation depends on the transformer design, but a typical or “standard” shielded isolation transformer will provide about 60 dB attenuation (10 KHz -10 MHz). Shielded isolation transformers are typically used where load equipment is sensitive to transients or to suppress transients from back-feeding onto the feeder circuits.

Unshielded Transformer



Shielded Transformer



Non-Linear Loads

What Are Non-Linear Loads?
When a sinusoidal voltage is applied to a “linear load,” the resultant current waveform takes on the shape of a sine wave as well. Typical linear loads are resistive heating and induction motors.

In contrast, non-linear load either:

- Draws current during only part of the cycle and acts as an open circuit for the balance of the cycle, or
- Changes the impedance during the cycle, hence the resultant waveform is distorted and no longer conforms to a pure sine wave shape.

In recent years, the use of electronic equipment proliferated in both offices and industrial plants. These electronic devices are powered by switching power supplies or some type of rectifier circuit. Examples of these devices used in offices are: computers, fax machines, copiers, printers, cash registers, UPS and solid-state ballasts, etc. In industrial plants, one will find other electronic devices like variable speed drives, HID lighting, solid-state starters and solid-state instruments, etc. They all contribute to the distortion of the current waveform and the generation of harmonics. As the use of electronic equipment increases and it makes up a significant portion of the electrical load, many concerns are raised about its impact on the electrical supply system.

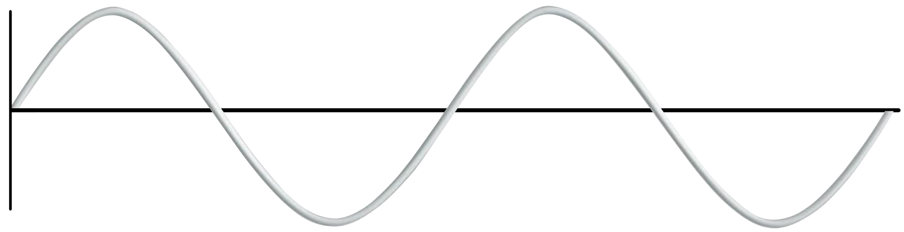
What Are Harmonics?
As defined by ANSI/IEEE Std. 519-1981, harmonic components are represented by a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency.

Harmonics superimpose themselves on the fundamentals waveform, distorting it and changing its magnitude.

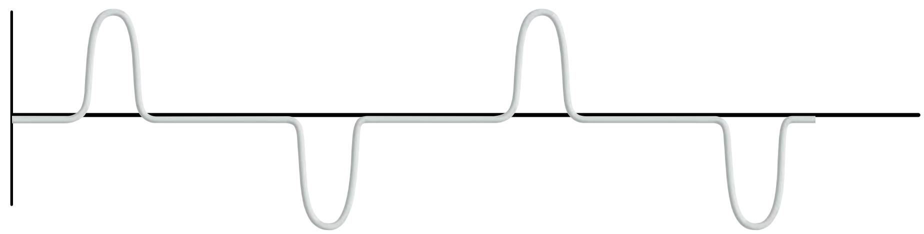
The percent of odd harmonics (3rd, 5th, 7th,...,25th,...) present in the load can affect the transformer, and this condition is called a “Non-Linear Load” or “Non-Sinusoidal Load.”

The total amount of harmonics will determine the percentage of non-linear load, which can be specified with the appropriate K-Factor rating.

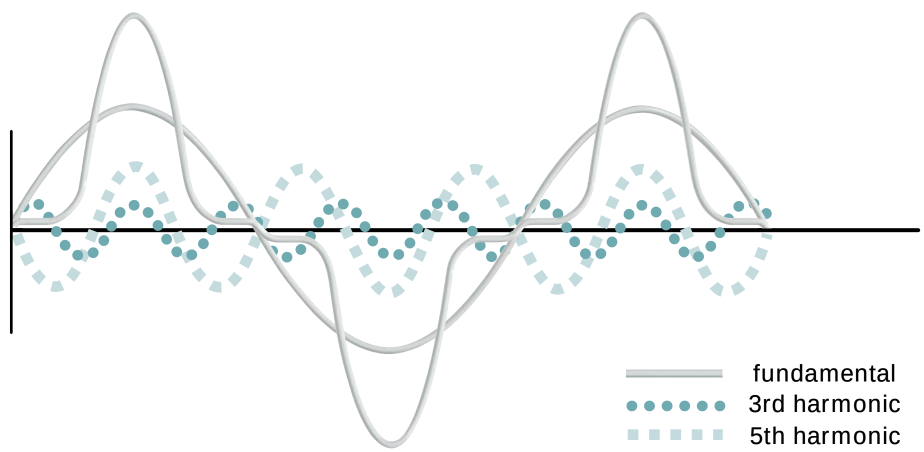
Voltage or Current Waveform for Linear Loads (Sine Wave)



Typical Current Waveform of Switching Power Supply



A Non-Linear Current and Its Fundamental, Plus 3rd and 5th Harmonic Components



Harmonics For 60 Hz Systems
In a 60Hz power system, the fundamental and harmonic frequencies are outlined in the table below.

Fundamental	60Hz
2nd Harmonic	120Hz
3rd Harmonic*	170Hz
4th Harmonic	240Hz
5th Harmonic	300Hz
6th Harmonic*	360Hz
7th Harmonic	420Hz
8th Harmonic	480Hz
9th Harmonic*	540Hz

*Triplen Harmonic

Effect Of Harmonics On Transformers
Non-sinusoidal current generates extra losses and heating of transformer coils thus reducing efficiency and shortening the life expectancy of the transformer.

Coil losses increase with the higher harmonic frequencies due to higher eddy current loss in the conductors.

Furthermore, on a balance linear power system, the phase currents are 120 degrees out of phase and they offset one another in the neutral conductor. But with the “Triplen” harmonics (multiple of 3) the phase current are in phase and they are additive in this neutral conductor. This may cause installations with non-linear load to be double either the size or the number of neutral conductors.

Motor Drive Isolation Transformers

With today's technological advances in solid-state power control devices, AC and DC variable speed motor drives have become more popular in many industrial applications. Siemens Drive Isolation Transformers are designed to meet the rugged demands of AC and DC variable speed drives and to provide circuit isolation from SCR's. They also provide the specific horsepower rating and voltage change to match the motor drive system. The cores are designed with reduced flux density to meet the inrush characteristics of drive applications. Windings are braced to withstand the mechanical stress and overload capacity needed for motor drive and SCR duty cycles. The separate primary and secondary windings provide electrical isolation between the incoming line and the load which minimizes line disturbances, feedback, and transients caused by SCR firing. When needed, an optional electrostatic shield can be provided between the primary and secondary windings to provide additional noise attenuation. Also available as an option is a thermal switch with 1-NC contact installed in each coil.

KVA	Motor H.P.②	Catalog Number	Standard Taps ①	Temperature Rise	Insulation	Mounting Type	Drip Shield Required ③
7.5	3 & 5	DT( )007	1 - 5% FCAN/BN	150°C	220°C	Floor & Wall	Yes
11	7.5	DT( )011	1 - 5% FCAN/BN	150°C	220°C	Floor & Wall	Yes
15	10	DT( )015	1 - 5% FCAN/BN	150°C	220°C	Floor & Wall	Yes
20	15	DT( )020	1 - 5% FCAN/BN	150°C	220°C	Floor & Wall	Yes
27	20	DT( )027	1 - 5% FCAN/BN	150°C	220°C	Floor & Wall	Yes
34	25	DT( )034	1 - 5% FCAN/BN	150°C	220°C	Floor & Wall	Yes
40	30	DT( )040	1 - 5% FCAN/BN	150°C	220°C	Floor & Wall	Yes
51	40	DT( )051	1 - 5% FCAN/BN	150°C	220°C	Floor & Wall	Yes
63	50	DT( )063	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
75	60	DT( )075	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
93	75	DT( )093	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
118	100	DT( )118	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
145	125	DT( )145	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
175	150	DT( )175	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
220	200	DT( )220	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
275	250	DT( )275	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
330	300	DT( )330	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
440	400	DT( )440	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
550	500	DT( )550	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes
660	600	DT( )660	1 - 5% FCAN/BN	150°C	220°C	Floor	Yes

DT( )Code	Primary Volts	Secondary Volts
22	230 Delta	230Y/133
24	230 Delta	460Y/266
42	460 Delta	230Y/133
44	460 Delta	460Y/266
52	575 Delta	230Y/133
54	575 Delta	460Y/266

Suffix Code	Optional Modification
ES	Electrostatic Shield
W	Wall Mtg. Brackets - 7.5 thru 51 KVA
DS	Drip Shields - 7.5 thru 330 KVA
TS	Thermal Switches

① Standard taps varies with KVA size based on the design volts/turn ratio.
② Refer to page 8 for additional information on horsepower. Ampere, and KVA ratings.
③ For outdoor application.

K-Factor

Measurement of Harmonics
For existing installations, the extent of the harmonics can be measured with appropriate instruments like “Power Harmonic Analyzer.” This service is offered by many consulting service organizations. For new construction, such information may not be obtainable, hence it is best to assume the “worst case” condition based on experience with the type and mix of loads.

Sizing Transformers for Non-Linear Loads
ANSI/IEEE C57.110-1986 has a procedure on de-rating standard distribution transformers for non-linear loading. However, this is not the only approach. A transformer with the appropriate K-Factor specifically designed for non-linear loads can be specified.

K-Factors
K-Factor is a ratio between the additional losses due to harmonics and the eddy losses at 60Hz. It is used to specify transformers for non-linear loads. Note that K-Factor transformers do not eliminate harmonic distortion, they withstand non-linear load condition without overheating.

Type	Linear Load Load	+	Non-Linear Load	K-Factor Value
K-4	100%		50%	4.0
K-13	100%		100%	13.0
K-20	100%		125%	20.0
K-30	100%		150%	30.0

50% Non-Linear Load (K4 Rating)

Harmonic (h)	Current (I)	I(pu)	$I(pu)^2h^2$
1	100.000%	1.000	1.000
3	16.667%	0.167	0.250
5	10.000%	0.100	0.250
7	7.143%	0.071	0.250
9	5.556%	0.056	0.250
11	4.545%	0.045	0.250
13	3.846%	0.038	0.250
15	3.333%	0.033	0.250
17	2.941%	0.029	0.250
19	2.632%	0.026	0.250
21	2.381%	0.024	0.250
23	2.174%	0.022	0.250
25	2.000%	0.020	0.250

K-Factor Σ(1h(pu)-h) = 4.0

100% Non-Linear Load (K13 Rating)

Harmonic (h)	Current (I)	I(pu)	$I(pu)^2h^2$
1	100.000%	1.000	1.000
3	33.333%	0.333	1.000
5	20.000%	0.200	1.000
7	14.286%	0.143	1.000
9	11.111%	0.111	1.000
11	9.091%	0.091	1.000
13	7.692%	0.077	1.000
15	6.667%	0.067	1.000
17	5.882%	0.059	1.000
19	5.263%	0.053	1.000
21	4.762%	0.048	1.000
23	4.348%	0.043	1.000
25	4.000%	0.040	1.000

K-Factor Σ(1h(pu)-h) = 13.0

125% Non-Linear Load (K20 Rating)

Harmonic (h)	Current (I)	I(pu)	$I(pu)^2h^2$
1	100.000%	1.000	1.000
3	41.667%	0.417	1.563
5	25.000%	0.250	1.563
7	17.857%	0.179	1.563
9	13.889%	0.139	1.563
11	11.364%	0.114	1.563
13	9.651%	0.096	1.563
15	8.333%	0.083	1.563
17	7.353%	0.074	1.563
19	6.579%	0.066	1.563
21	5.952%	0.060	1.563
23	5.435%	0.054	1.563
25	5.000%	0.050	1.563

K-Factor Σ(1h(pu)-h) = 19.756

150% Non-Linear Load (K30 Rating)

Harmonic (h)	Current (I)	I(pu)	$I(pu)^2h^2$
1	100.000%	1.000	1.000
3	50.000%	0.500	2.250
5	30.000%	0.300	2.250
7	21.429%	0.214	2.250
9	16.667%	0.167	2.250
11	13.636%	0.136	2.250
13	11.538%	0.115	2.250
15	10.000%	0.100	2.250
17	8.824%	0.088	2.250
19	7.895%	0.079	2.250
21	7.143%	0.071	2.250
23	6.522%	0.065	2.250
25	6.000%	0.060	2.250

K-Factor Σ(1h(pu)-h) = 28.0

Note: In the examples above the amount of non-linear load specified, the percentage of fundamental, and the percentage of harmonic factor are arbitrary values; actual values may vary. Consult sales office for your specific application with current values for each harmonic.

K-Factor

K-Factor 4 with Electrostatic Shield ①

KVA	480Δ 208Y/120	Taps	Temp. Rise	Insulation
15	3F3Y015K4	2 - 2½% FCAN 4 - 2½% FCBN	150°C	220°C
30	3F3Y030K4			
45	3F3Y045K4			
75	3F3Y075K4			
112.5	3F3Y112K4			
150	3F3Y150K4	2 - 2½% FCAN 4 - 2½% FCBN	150°C	220°C
225	3F3Y225K4			
300	3F3Y300K4			
500	3F3Y500K4			

K-Factor 13 with Electrostatic Shield ①

KVA	480Δ 208Y/120	Taps	Temp. Rise	Insulation
15	3F3Y015K13	2 - 2½% FCAN 4 - 2½% FCBN	150°C	220°C
30	3F3Y030K13			
45	3F3Y045K13			
75	3F3Y075K13			
112.5	3F3Y112K13			
150	3F3Y150K13	2 - 2½% FCAN 4 - 2½% FCBN	150°C	220°C
225	3F3Y225K13			
300	3F3Y300K13			
500	3F3Y500K13			

K-Factor 20 with Electrostatic Shield ①

KVA	480Δ 208Y/120	Taps	Temp. Rise	Insulation
15	3F3Y015K20	2 - 2½% FCAN 4 - 2½% FCBN	150°C	220°C
30	3F3Y030K20			
45	3F3Y045K20			
75	3F3Y075K20			
112.5	3F3Y112K20			
150	3F3Y150K20	2 - 2½% FCAN 4 - 2½% FCBN	150°C	220°C
225	3F3Y225K20			
300	3F3Y300K20			
500	3F3Y500K20			

K-Factor 30 with Electrostatic Shield ①

KVA	480Δ 208Y/120	Taps	Temp. Rise	Insulation
15	3F3Y015K30	2 - 2½% FCAN 4 - 2½% FCBN	150°C	220°C
30	3F3Y030K30			
45	3F3Y045K30			
75	3F3Y075K30			
112.5	3F3Y112K30			
150	3F3Y150K30	2 - 2½% FCAN 4 - 2½% FCBN	150°C	220°C
225	3F3Y225K30			
300	3F3Y300K30			
500	3F3Y500K30			

① Refer to page 5 for other optional modifications.

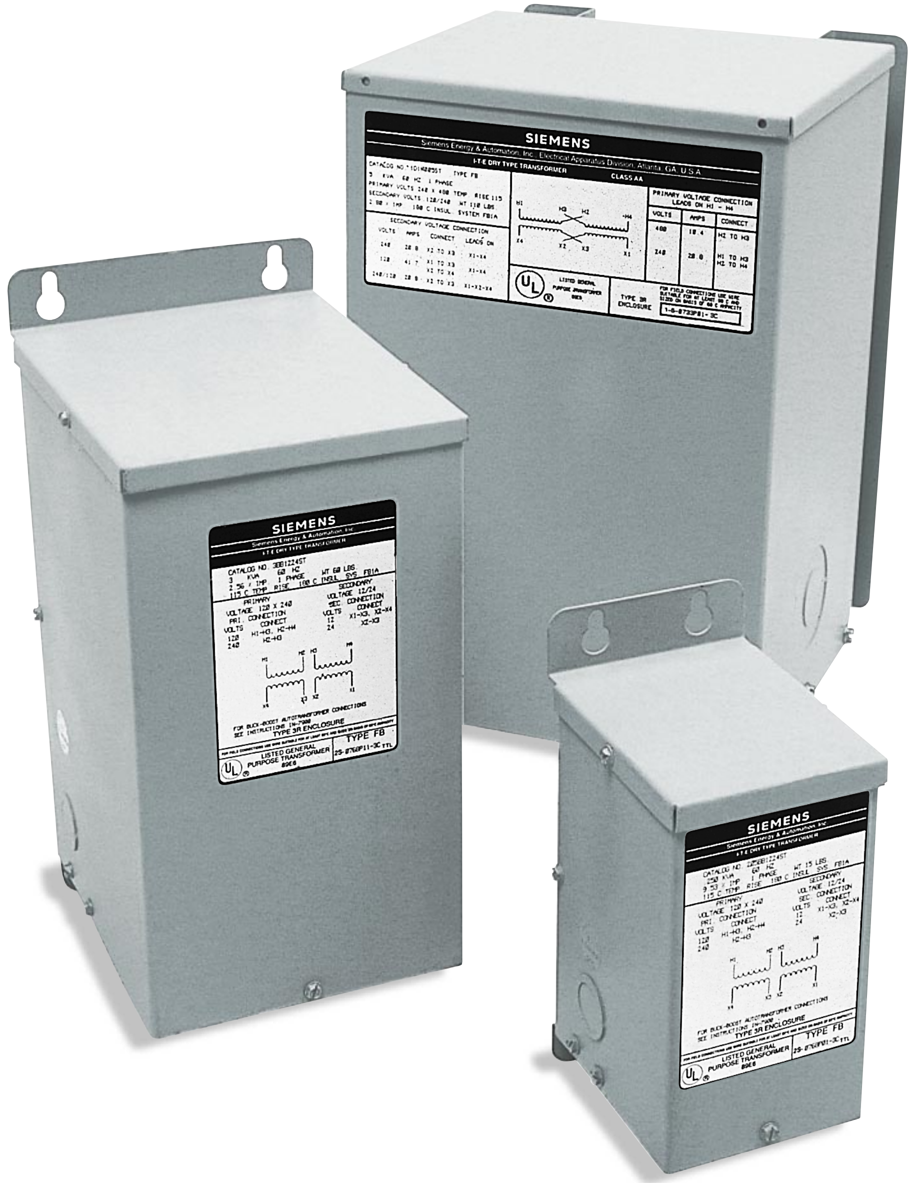
Standard Features

- Designed to ANSI and NEMA Standards
- UL K-Factor listed per UL 1561
- K-Factor rating designed to IEEE C57.110
- Aluminum wound coils
- 150°C Rise, 220°C insulation
- Core, conductors designed for Harmonics and Eddy currents
- 200% neutral bar (2x phase current)
- Electrostatic shield to attenuate line transients
- NEMA 1 enclosure

Options

- Other K-Factor ratings
- Other voltage ratings
- 80°C or 115°C temperature rise
- Copper windings
- Low noise
- Drip Shields for NEMA 3R Enclosure
- Wall Mounting Brackets (15-50 kVA)

Buck-Boost Transformers



Application
The Buck-Boost Transformer has four separate windings, two-windings in the primary and two-windings in the secondary. The unit is designed for use as an insulating fransformer or as an autotransformer. As an autotransformer the unit can be corrected to Buck (decrease) or Boost (increase) a supply voltage. When connected in either the Buck or Boost mode, the unit is no longer an insulating transformer but is an autotransformer.

Autotransformers are more economical and physically smaller then equivalent two-winding transformers and are designed to carry the same function as two-winding transformers, with the exception of isolating two circuits. Since autotransformers may transmit line disturbances directly, they may be prohibited in some areas by local building codes. Before applying them, care should be taken to assure that they are acceptable to local code.

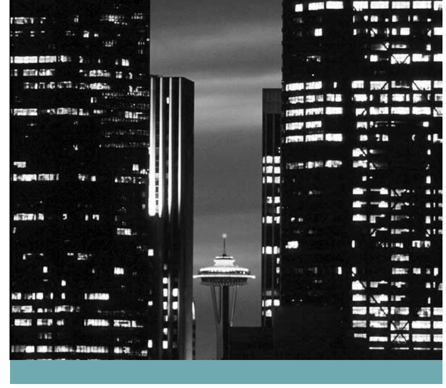
Note: Autotransformers are not used in closed delta connections as they introduce into the circuit a phase shift which makes them uneconomical.

As insulating transformers these units can accommodate a high voltage of 120, 240, or 480 volts. For units with two 12 volt secondaries, two 16 volt secondaries, or two 24 volt secondaries, the output can be wired for either secondary voltage, or for 3-wire secondary. The unit is rated (KVA) as any conventional transformer.

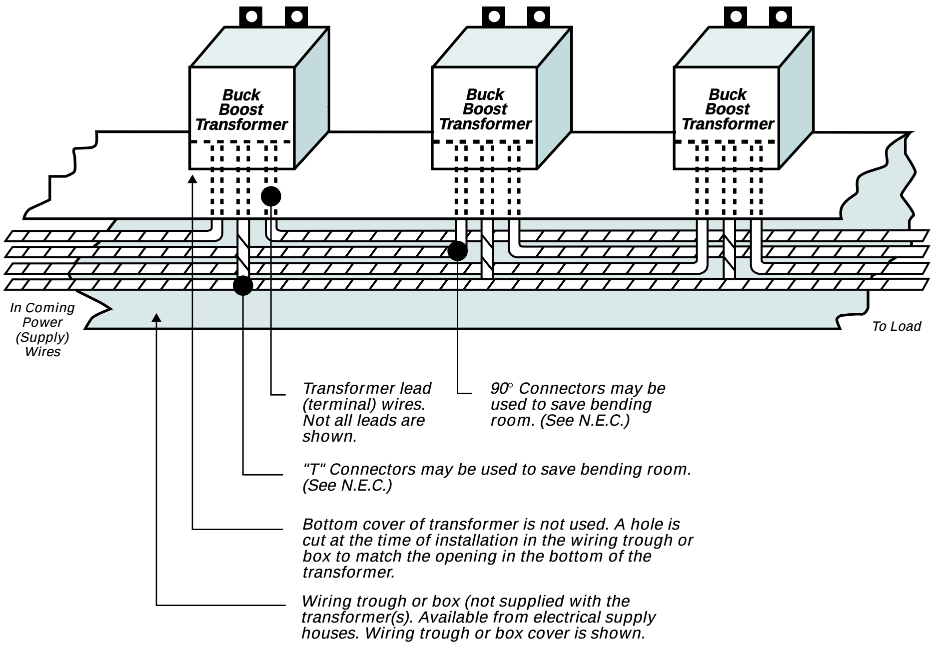
Operation
Electrical and electronic equipment is designed to operate on a standard supply voltage. When the supply voltage is constantly too high or too low (usually greater than ± 5%) the equipment fails to operate at maximum efficiency. A Buck-Boost transformer is a simple and economical means of correcting this off-standard voltage up to ± 20%. A Buck-Boost Transformer will NOT, however, stabilize a fluctuating voltage.

Buck-Boost transformers are suitable for use as a three phase autotransformer bank in either direction to supply 3-wire loads. They are also suitable for use in a three-phase autotransformer bank which provides a neutral return for unbalanced current. They are NOT suitable for use in a three phase autotransformer bank to supply a 4-wire unbalanced load when the source is a 3-wire circuit.

120 x 240 Pri. - 12/24 Sec.		120 x 240 Pri. - 16/32 Sec.		240 x 480 Pri. - 24/48 Sec.	
KVA	Catalog Number	KVA	Catalog Number	KVA	Catalog Number
.050	050BB1224	.050	050BB1632	.050	050BB2448
.100	100BB1224	.100	100BB1632	.100	100BB2448
.150	150BB1224	.150	150BB1632	.150	150BB2448
.250	205BB1224	.250	205BB1632	.250	205BB2448
.500	505BB1224	.500	505BB1632	.500	505BB2448
.750	705BB1224	.750	705BB1632	.750	705BB2448
1.00	1BB1224	1.00	1BB1632	1.00	1BB2448
1.50	105BB1224	1.50	105BB1632	1.50	105BB2448
2.00	2BB1224	2.00	2BB1632	2.00	2BB2448
3.00	3BB1224	3.00	3BB1632	3.00	3BB2448
5.00	5BB1224	5.00	5BB1632	5.00	5BB2448



Typical Three Phase Buck-Boost Autotransformer Installation



Use quantity of Buck-Boost Transformer(s) indicated on chart for connection to be made. Quantity required may vary from quantity shown in this illustration. CAUTION: Refer to National Electrical Code Article 373-4 for determining wire bending space.

How to Select the Proper Transformer

To select the proper Transformer for Buck-Boost applications, determine:

1. Input line voltage - The voltage that you want to buck (decrease) or boost (increase). This can be found by measuring the supply line voltage with a voltmeter.
2. Load voltage - The voltage at which your equipment is designed to operate. This is listed on the nameplate of the load equipment.
3. Load KVA or Load Amps - You do not need to know both - one or the either is sufficient for selection purposes.This information usually can be found on the nameplate of the equipment that you want to operate.
4. Number of phases - Single or three phase line and load should match because a transformer is not capable of converting single to three phase. It is however, a common application to make a single phase transformer connection from a three phase supply by use of one leg of the three phase supply circuit. Care must always be taken not to overload the leg of the three phase supply. This is particularly true in a Buck-Boost application because the supply must provide for the load KVA, not just the name plate rating of the Buck-Boost transformer.
5. Frequency - The supply line frequency must be the same as the frequency of the equipment to be operated - either 50 or 60 cycles.

How to Use Selection Charts

1. Choose the selection table with the correct number of phases for single or three phase applications.
2. Line/Load voltage combinations are listed across the top of the selection table. Select a line/load voltage combination which comes closest to matching your application.
3. Follow the selected column down until you find either the load KVA or load amps of your application. If you do not find the exact value, go on the next highest rating.
4. Now follow the column across the table to the far left-hand side to find the catalog number and KVA of the transformer you need.
5. Follow the column of your line/load voltage to the bottom to find the connection diagram for this application. NOTE: Connection diagrams show low voltage and high voltage connection terminals. Either can be input or output depending on Buck or Boost application.
6. In the case of three phase loads either two or three single phase transformers are required as indicated in the “quantity required” line at the bottom of the table. The selection is dependent on whether a Wye connected bank of three transformers with a neutral is required or whether an open Delta connected bank of two transformers for a Delta connected load will be suitable.
7. For line/load voltage not listed on the selection tables, use the pair listed on the table that is slightly above your application for reference. Then apply the first formula at the bottom of the table to determine “new” output voltage. The new KVA rating can be found using the second formula.

Buck-Boost Transformers

120 x 240 Volts Primary - 12/24 Volts Secondary - 60Hz - No Taps - Wall Mounted

Single Phase - Table 1		Boosting								Bucking					
Catalog Number	Line Voltage (Available)	95	100	105	109	189	208	215	220	125	132	229	245	250	252
Insulating Transformer Rating	Load Voltage (Output)	114	120	115	120	208	229	237	242	113	120	208	222	227	240
050BB2448 .050 KVA	KVA Load Amps	.24 2.08	.25 2.08	.50 4.17	.50 4.17	.43 2.08	.48 2.08	.49 2.08	.50 2.08	.52 4.59	.55 4.59	.48 2.29	.51 2.29	.52 2.29	1.05 4.38
100BB2448 .100 KVA	KVA Load Amps	.48 4.17	.50 4.17	.96 8.33	1.00 8.33	.87 4.17	.95 4.17	.99 4.17	1.01 4.17	1.04 9.16	1.10 9.16	.95 4.58	1.02 4.58	1.04 4.58	2.10 8.75
150BB2448 .150 KVA	KVA Load Amps	.72 6.25	.75 6.25	1.44 12.50	1.50 12.50	1.30 6.25	1.43 6.25	1.48 6.25	1.51 6.25	1.55 13.75	1.65 13.75	1.43 6.88	1.53 6.88	1.56 6.88	3.15 13.13
205BB2448 .250 KVA	KVA Load Amps	1.19 10.42	1.25 10.42	2.40 20.83	2.50 20.83	2.17 10.42	2.38 10.42	2.47 10.42	2.52 10.42	2.60 22.92	2.75 22.92	2.38 11.46	2.54 11.46	2.60 11.46	5.25 21.88
505BB2448 .500 KVA	KVA Load Amps	2.37 20.83	2.50 20.83	4.80 41.67	5.00 41.67	4.33 20.83	4.77 20.83	4.94 20.83	5.04 20.83	5.18 45.83	5.50 45.83	4.77 22.92	5.09 22.92	5.20 22.92	10.50 43.75
705BB2448 .750 KVA	KVA Load Amps	3.56 31.25	3.75 31.25	7.19 62.50	7.50 62.50	6.50 31.25	7.15 31.25	7.41 31.25	7.56 31.25	7.77 68.75	8.25 68.75	7.15 34.38	7.63 34.38	7.80 34.38	15.75 65.63
1BB2448 1.00 KVA	KVA Load Amps	4.75 41.67	5.00 41.67	9.58 83.33	10.00 83.33	8.67 41.67	9.53 41.67	9.88 41.67	10.08 41.67	10.36 91.66	11.00 91.66	9.53 45.83	10.17 45.83	10.40 45.83	21.00 87.50
105BB2448 1.50 KVA	KVA Load Amps	7.13 62.50	7.50 62.50	14.38 125.00	15.00 125.00	13.00 62.50	14.30 62.50	14.81 62.50	15.13 62.50	15.54 137.50	16.50 137.50	14.30 68.75	15.26 68.75	15.61 68.75	31.50 131.25
2BB2448 2.00 KVA	KVA Load Amps	9.50 83.33	10.00 83.33	19.17 166.66	20.00 166.66	17.33 83.33	19.07 83.33	19.75 83.33	20.17 83.33	20.72 183.33	22.00 183.33	19.07 91.66	20.35 91.66	20.81 91.66	42.00 175.00
3BB2448 3.00 KVA	KVA Load Amps	14.25 125.00	15.00 125.00	28.75 250.00	30.00 250.00	26.00 125.00	28.60 125.00	29.63 125.00	30.25 125.00	31.08 275.00	33.00 275.00	28.60 137.50	30.53 137.50	31.21 137.50	63.00 262.50
5BB2448 5.00 KVA	KVA Load Amps	23.75 208.33	25.00 208.33	47.92 416.66	50.00 416.66	43.33 208.33	47.67 208.33	49.37 208.33	50.42 208.33	51.79 458.33	55.00 458.33	47.67 229.17	50.88 229.17	52.02 229.17	105.00 437.50
Connection Diagram		B	B	A	A	D	D	D	D	A	A	D	D	D	C

Three Phase - Table 2		Boosting								Bucking					
Catalog Number	Line Voltage (Available)	189Y 109	195Y 113	200Y 115	208Y 120	416Y 240	416Y 240	189	208	220	218	229	250	255	264
Insulating Transformer Rating	Load Voltage (Output)	208	234	240	229	457	436	208	229	242	208	208	227	232	240
050BB2448 .050 KVA	KVA Load Amps	1.50 4.17	.84 2.08	.86 2.08	1.65 4.17	1.65 2.08	3.15 4.17	.75 2.08	.83 2.08	.87 2.08	1.58 4.39	.83 2.29	.90 2.29	.92 2.29	.95 2.29
100BB2448 .100 KVA	KVA Load Amps	3.00 8.33	1.69 4.17	1.73 4.17	3.30 8.33	3.30 4.17	6.29 8.33	1.50 4.17	1.65 4.17	1.75 4.17	3.15 8.75	1.65 4.58	1.80 4.58	1.84 4.58	1.90 4.58
150BB2448 .150 KVA	KVA Load Amps	4.50 12.50	2.54 6.25	2.60 6.25	4.96 12.50	4.96 6.25	9.44 12.50	2.26 6.25	2.48 6.25	2.62 6.25	4.73 13.13	2.48 6.88	2.71 6.88	2.76 6.88	2.86 6.88
205BB2448 .250 KVA	KVA Load Amps	7.50 20.83	4.22 10.42	4.33 10.42	8.30 20.83	8.25 10.42	15.75 20.83	3.75 10.42	4.13 10.42	4.37 10.42	7.88 21.88	4.13 11.46	4.50 11.46	4.61 11.46	4.76 11.46
505BB2448 .500 KVA	KVA Load Amps	15.01 41.67	8.44 20.83	8.66 20.83	16.60 41.67	16.50 20.83	31.50 41.67	7.50 20.83	8.26 20.83	8.73 20.83	15.76 43.75	8.26 22.92	9.01 22.92	9.21 22.92	9.53 22.92
705BB2448 .750 KVA	KVA Load Amps	22.52. 62.50	12.67 31.25	12.99 31.25	24.90 62.50	24.75 31.25	47.25 62.50	11.26 31.25	12.39 31.25	13.10 31.25	23.64 65.63	12.39 34.38	13.52 34.38	13.82 34.38	14.29 34.38
1BB2448 1.00 KVA	KVA Load Amps	30.02 83.33	16.89 41.67	17.32 41.67	33.20 83.33	33.00 41.67	63.00 83.33	15.01 41.67	16.51 41.67	17.47 41.67	31.52 87.50	16.51 45.83	18.02 45.83	18.42 45.83	19.05 45.83
105BB2448 1.50 KVA	KVA Load Amps	45.03 125.00	25.33 62.50	25.98 62.50	49.80 125.00	49.50 62.50	94.50 125.00	22.52 62.50	24.77 62.50	26.20 62.50	47.28 131.25	24.77 68.75	27.03 68.75	27.63 68.75	28.53 68.75
2BB2448 2.00 KVA	KVA Load Amps	60.06 166.67	33.77 83.33	34.64 83.33	66.40 166.67	66.00 83.33	126.00 166.66	30.02 83.33	33.03 83.33	34.93 83.33	63.05 175.00	33.03 91.67	36.04 91.67	36.84 91.67	38.11 91.67
3BB2448 3.00 KVA	KVA Load Amps	90.07 250.00	50.66 125.00	51.96 125.00	99.59 250.00	99.00 125.00	189.00 250.00	45.03 125.00	49.54 125.00	52.39 125.00	94.57 262.50	49.54 137.50	54.06 137.50	55.25 137.50	57.16 137.50
5BB2448 5.00 KVA	KVA Load Amps	150.11 416.67	84.44 208.33	86.60 208.33	165.00 416.67	165.00 208.33	318.00 416.66	75.05 208.33	82.56 208.33	87.32 208.33	157.62 437.50	82.56 229.17	90.10 229.17	92.09 229.17	95.26 229.17
Quantity Required		3	3	3	3	3	3	2	2	2	2	2	2	2	2
Connection Diagram		F	E	E	F	J	K	G	G	G	H	G	G	G	G

*Output voltage for lower input voltage can be found by: $\frac{\text{Rated Output Voltage}}{\text{Rated Input Voltage}}$ x Input Actual Voltage = Output New Voltage.

Buck-Boost Transformers

120 x 240 Volts Primary - 16/32 Volts Secondary - 60Hz - No Taps - Wall Mounted

Single Phase - Table 3		Boosting								Bucking					
Catalog Number	Line Voltage (Available)	95	100	105	208	215	215	220	225	135	240	240	245	250	255
Insulating Transformer Rating	Load Voltage (Output)	120	114	119	240	244	230	235	240	119	208	225	230	234	239
050BB1632	KVA	.19	.36	.37	.37	.38	.72	.73	.73	.42	.37	.75	.77	.78	.80
.050 KVA	Load Amps	1.56	3.12	3.12	1.56	1.56	3.12	3.12	3.12	3.54	1.77	3.33	3.33	3.33	3.33
100BB1632	KVA	.38	.72	.74	.74	.76	1.44	1.46	1.50	.84	.74	1.50	1.54	1.56	1.60
.100 KVA	Load Amps	3.13	6.25	6.25	3.13	3.13	6.25	6.25	6.25	7.09	3.54	6.66	6.66	6.66	6.66
150BB1632	KVA	.56	1.06	1.12	1.12	1.14	2.16	2.20	2.26	1.26	1.10	2.26	2.30	2.34	2.40
.150 KVA	Load Amps	4.69	9.38	9.38	4.69	4.69	9.38	9.38	9.38	10.64	5.30	10.02	10.02	10.02	10.02
205BB1632	KVA	.94	1.78	1.86	1.88	1.91	3.59	3.67	3.75	2.11	1.84	3.75	3.83	3.90	3.98
.250 KVA	Load Amps	7.81	15.63	15.63	7.81	7.81	15.63	15.63	15.63	17.71	8.85	16.67	16.67	16.67	16.67
505BB1632	KVA	1.88	3.56	3.72	3.75	3.81	7.19	7.34	7.50	4.21	3.68	7.50	7.67	7.80	7.97
.500 KVA	Load Amps	15.63	31.25	31.25	15.63	15.63	31.25	31.25	31.25	35.42	17.71	33.33	33.33	33.33	33.33
705BB1632	KVA	2.81	5.34	5.58	5.63	5.72	10.78	11.02	11.25	6.32	5.53	11.25	11.50	11.70	11.95
.750 KVA	Load Amps	23.44	46.88	46.88	23.44	23.44	46.88	46.88	46.88	53.13	26.56	50.00	50.00	50.00	50.00
1BB1632	KVA	3.75	7.13	7.44	7.50	7.63	14.38	14.69	15.00	8.43	7.37	15.00	15.33	15.60	15.93
1.00 KVA	Load Amps	31.25	62.50	62.50	31.25	31.25	62.50	62.50	62.50	70.83	35.42	66.67	66.67	66.67	66.67
105BB1632	KVA	5.63	10.69	11.16	11.25	11.44	21.56	22.03	22.50	12.64	11.05	22.50	23.00	23.40	23.90
1.50 KVA	Load Amps	46.90	93.80	93.80	46.90	46.90	93.80	93.80	93.80	106.30	53.10	100.00	100.00	100.00	100.00
2BB1632	KVA	7.50	14.25	14.88	15.00	15.25	28.75	29.38	30.00	16.86	14.73	30.00	30.67	31.20	31.87
2.00 KVA	Load Amps	62.50	125.00	125.00	62.50	62.50	125.00	125.00	125.00	141.70	70.80	133.30	133.30	133.30	133.30
3BB1632	KVA	11.25	21.38	22.31	22.50	22.88	43.13	44.06	45.00	25.29	22.10	45.00	46.00	46.80	47.80
3.00 KVA	Load Amps	93.80	187.50	187.50	93.80	93.80	187.50	187.50	187.50	212.50	106.30	200.00	200.00	200.00	200.00
5BB1632	KVA	18.75	35.63	37.19	37.50	38.13	71.88	73.44	75.00	42.15	36.83	75.00	76.67	78.00	79.67
5.00 KVA	Load Amps	156.30	312.50	312.50	156.30	156.30	312.50	312.50	312.50	354.20	177.10	333.30	333.30	333.30	333.30
Connection Diagram		B	A	A	D	D	C	C	C	A	D	C	C	C	C

Three Phase - Table 4		Boosting					Bucking					
Catalog Number	Line Voltage (Available)	183Y 106	208Y 120	195	208	225	240	245	250	256	265	272
Insulating Transformer Rating	Load Voltage (Output)	208	236	208	240	240	208	230	234	240	234	240
050BB1632	KVA	1.13	1.28	1.13	.62	1.30	.56	1.33	1.35	1.39	.72	.74
.050 KVA	Load Amps	3.13	3.13	3.13	1.56	3.13	1.56	3.34	3.34	3.34	1.77	1.77
100BB1632	KVA	2.25	2.55	2.25	1.30	2.60	1.13	2.66	2.70	2.77	1.44	1.48
.100 KVA	Load Amps	6.25	6.25	6.25	3.13	6.25	3.13	6.67	6.67	6.67	3.55	3.55
150BB1632	KVA	3.38	3.83	3.38	1.95	3.90	1.69	3.98	4.05	4.16	2.15	2.21
.150 KVA	Load Amps	9.38	9.38	9.38	4.69	9.38	4.69	10.00	10.00	10.00	5.31	5.31
205BB1632	KVA	5.63	6.39	5.63	3.17	6.50	2.81	6.64	6.76	6.93	3.59	3.68
.250 KVA	Load Amps	15.63	15.63	15.63	7.81	15.63	7.81	16.67	16.67	16.67	8.85	8.85
505BB1632	KVA	11.26	12.77	11.26	6.33	12.99	5.63	13.28	13.50	13.86	7.17	7.36
.500 KVA	Load Amps	31.25	31.25	31.25	15.63	31.25	15.63	33.33	33.33	33.33	17.69	17.71
705BB1632	KVA	16.89	19.16	16.89	9.50	19.49	8.44	19.92	20.26	20.78	10.76	11.04
.750 KVA	Load Amps	46.88	46.88	46.88	23.44	46.88	23.44	50.00	50.00	50.00	26.54	26.56
1BB1632	KVA	22.52	25.55	22.52	12.67	25.98	11.26	26.56	27.02	27.71	14.34	14.72
1.00 KVA	Load Amps	62.50	62.50	62.50	31.25	62.50	31.25	66.67	66.67	66.67	35.39	35.42
105BB1632	KVA	33.77	38.32	33.77	19.00	38.97	16.89	39.84	40.53	41.57	21.52	22.08
1.50 KVA	Load Amps	93.75	93.75	93.75	46.88	93.75	46.88	100.00	100.00	100.00	53.08	53.13
2BB1632	KVA	45.03	51.10	46.03	25.33	51.96	22.52	53.11	54.04	55.43	28.69	29.44
2.00 KVA	Load Amps	125.00	125.00	125.00	62.50	125.00	62.50	133.33	133.33	133.33	70.78	70.83
3BB1632	KVA	67.55	76.64	67.55	38.00	77.94	33.77	79.67	81.06	83.14	43.03	44.17
3.00 KVA	Load Amps	187.50	187.50	187.50	93.75	187.50	93.75	200.00	200.00	200.00	106.17	106.25
5BB1632	KVA	112.58	127.74	112.58	63.33	129.90	56.29	132.79	135.09	138.56	71.72	73.61
5.00 KVA	Load Amps	312.50	312.50	312.50	156.25	312.50	156.25	333.33	333.33	333.33	176.95	177.08
Quantity Required		3	3	2	2	2	2	2	2	2	2	2
Connection Diagram		F	F	H	G	H	L	H	H	H	G	G

*Output KVA available at reduced input voltage can be found by: $\frac{\text{Actual Input Voltage}}{\text{Rated Input Voltage}} \times \text{Output KVA} = \text{New KVA Rating.}$

Buck-Boost Transformers

240 x 480 Volts Primary - 24/48 Volts Secondary - 60Hz - No Taps - Wall Mounted

Single Phase - Table 5		Boosting										Bucking			
Catalog Number	**Line Voltage (Available)**	**230**	**380**	**416**	**425**	**430**	**435**	**440**	**440**	**450**	**460**	**277**	**480**	**480**	**504**
Insulating Transformer Rating	**Load Voltage (Output)**	**277**	**420**	**457**	**467**	**473**	**457**	**462**	**484**	**472**	**483**	**230**	**436**	**456**	**480**
050BB1224	KVA	.29	.44	.48	.49	.49	.95	.96	.50	.98	1.01	.29	.50	1.05	1.10
.050 KVA	Load Amps	1.04	1.04	1.04	1.04	1.04	2.08	2.08	1.04	2.08	2.08	1.25	1.15	2.29	2.29
100BB1224	KVA	.58	.87	.95	.97	.99	1.90	1.93	1.01	1.97	2.01	.58	1.00	2.09	2.20
.100 KVA	Load Amps	2.08	2.08	2.08	2.08	2.08	4.17	4.17	2.08	4.17	4.17	2.50	2.29	4.58	4.58
150BB1224	KVA	.87	1.31	1.43	1.46	1.48	2.86	2.89	1.51	2.95	3.02	.86	1.50	3.14	3.00
.150 KVA	Load Amps	3.13	3.13	3.13	3.13	3.13	6.25	6.25	3.13	6.25	6.25	3.75	3.44	6.88	6.88
205BB1224	KVA	1.44	2.19	2.38	2.43	2.46	4.76	4.81	2.52	4.92	5.03	1.44	2.50	5.23	5.50
.250 KVA	Load Amps	5.21	5.21	5.21	5.21	5.21	5.21	10.42	5.21	10.42	10.42	6.25	5.73	11.46	11.46
505BB1224	KVA	2.89	4.38	4.76	4.86	4.93	9.52	9.62	5.04	9.83	10.06	2.88	5.00	10.45	11.00
.500 KVA	Load Amps	10.42	10.42	10.42	10.42	10.42	20.83	20.83	10.42	20.83	20.83	12.50	11.46	22.92	22.92
705BB1224	KVA	4.33	6.56	7.14	7.30	7.39	14.28	14.44	7.56	14.75	15.09	4.31	7.49	15.68	16.50
.750 KVA	Load Amps	15.63	15.63	15.63	15.63	15.63	31.25	31.25	15.63	31.25	31.25	18.75	17.19	34.38	34.38
1BB1224	KVA	5.77	8.57	9.52	9.73	9.85	19.04	19.25	10.08	19.67	20.13	5.75	9.99	20.90	22.00
1.00 KVA	Load Amps	20.83	20.83	20.83	20.83	20.83	41.67	41.67	20.83	41.67	41.67	25.00	22.92	45.83	45.83
105BB1224	KVA	8.66	13.13	14.28	14.59	14.78	28.56	28.88	15.13	29.50	30.19	8.63	14.99	31.25	33.00
1.50 KVA	Load Amps	31.25	31.25	31.25	31.25	31.25	62.50	62.50	31.25	62.50	62.50	37.50	34.38	68.75	68.75
2BB1224	KVA	11.54	17.50	19.04	19.46	19.71	38.08	38.50	20.17	39.33	40.25	11.50	19.98	41.80	44.00
2.00 KVA	Load Amps	41.67	41.67	41.67	41.67	41.67	83.33	83.33	41.67	83.33	83.33	50.00	45.83	91.67	91.67
3BB1224	KVA	17.31	26.25	28.56	29.19	29.56	57.13	57.75	30.25	59.00	60.38	17.25	29.98	62.70	66.00
3.00 KVA	Load Amps	62.50	62.50	62.50	62.50	62.50	125.00	125.00	62.50	125.00	125.00	75.00	68.80	137.50	137.50
5BB1224	KVA	28.90	43.80	47.60	48.60	49.30	95.20	96.20	50.40	98.30	100.60	28.80	50.00	104.50	110.00
5.00 KVA	Load Amps	104.20	104.20	104.20	104.20	104.20	208.30	208.30	104.20	208.30	208.30	125.00	114.60	229.20	229.20
Connection Diagram		**B**	**D**	**D**	**D**	**D**	**C**	**C**	**D**	**C**	**C**	**B**	**D**	**C**	**C**

Three Phase - Table 6		Boosting								Bucking							
Catalog Number	**Line Voltage (Available)**	**399Y 230**	**380**	**430**	**440**	**460**	**460**	**480**	**480**	**440**	**440**	**460**	**460**	**480**	**480**	**500**	**500**
Insulating Transformer Rating	**Load Voltage (Output)**	**480Y 277**	**420**	**473**	**462**	**506**	**483**	**528**	**504**	**400**	**419**	**438**	**418**	**457**	**436**	**455**	**477**
050BB1224	KVA	.86	.76	.85	1.66	.91	1.74	.95	1.82	.79	1.58	1.66	.83	1.73	.86	.90	1.80
.050 KVA	Load Amps	1.04	1.04	1.04	2.08	1.04	2.08	1.04	2.08	1.14	2.18	2.18	1.14	2.18	1.14	1.14	2.18
100BB1224	KVA	1.73	1.51	1.70	3.33	1.82	3.48	1.90	3.63	1.59	3.17	3.31	1.66	3.46	1.73	1.80	3.61
.100 KVA	Load Amps	2.08	2.08	2.08	4.16	2.08	4.16	2.08	4.16	2.29	4.37	4.37	2.29	4.37	2.29	2.29	4.37
150BB1224	KVA	2.60	2.27	2.56	4.99	2.73	5.22	2.85	5.45	2.38	4.75	4.97	2.48	5.19	2.59	2.70	5.41
.150 KVA	Load Amps	3.12	3.12	3.12	6.24	3.12	6.25	3.12	6.24	3.43	6.55	6.55	3.43	6.55	3.43	3.43	6.55
205BB1224	KVA	4.33	3.78	4.26	8.32	4.56	8.70	4.76	9.08	3.96	7.92	8.28	4.14	8.64	4.32	4.51	9.02
.250 KVA	Load Amps	5.20	5.20	5.20	10.40	5.20	10.40	5.20	10.40	5.72	10.92	10.92	5.72	10.92	5.72	5.72	10.92
505BB1224	KVA	8.60	7.56	8.52	16.64	9.11	17.40	9.51	18.16	7.93	15.85	16.57	8.28	17.29	8.64	9.02	18.04
.500 KVA	Load Amps	10.40	10.40	10.40	20.80	10.40	20.80	10.40	20.80	11.44	21.84	21.84	11.44	21.84	11.44	11.44	21.84
705BB1224	KVA	12.90	11.34	12.77	24.97	13.67	26.10	14.27	27.24	11.89	23.77	24.85	12.42	25.93	12.96	13.52	27.07
.750 KVA	Load Amps	15.60	15.60	15.60	31.20	15.60	31.20	15.60	31.20	17.16	32.76	32.76	17.16	32.76	17.16	17.16	32.76
1BB1224	KVA	17.30	15.12	17.03	33.29	18.23	34.80	19.02	36.31	15.85	31.70	33.14	16.57	34.57	17.28	18.03	36.09
1.00 KVA	Load Amps	20.80	20.80	20.80	41.60	20.80	41.60	20.80	41.60	22.88	43.68	43.68	22.88	43.68	22.88	22.88	43.68
105BB1224	KVA	25.90	22.69	25.55	49.93	27.34	52.50	28.53	54.47	23.78	47.55	49.71	24.85	51.86	25.92	27.05	54.13
1.50 KVA	Load Amps	31.20	31.20	31.20	62.40	31.20	62.40	31.20	62.40	34.32	65.52	65.52	34.32	65.62	34.32	34.32	65.52
2BB1224	KVA	34.60	30.25	34.07	66.58	36.46	69.60	38.04	72.63	31.70	63.40	66.27	33.13	69.15	34.56	36.06	72.18
2.00 KVA	Load Amps	41.60	41.60	41.60	83.20	41.60	83.20	41.60	83.20	45.76	87.36	87.36	45.76	87.36	45.76	45.76	87.36
3BB1224	KVA	52.00	45.45	51.18	100.03	54.69	104.57	57.07	109.12	47.63	95.25	99.57	49.77	103.89	51.92	54.18	108.44
3.00 KVA	Load Amps	62.50	62.50	62.50	125.00	62.50	125.00	62.50	125.00	68.75	131.25	131.25	68.75	131.25	68.75	68.75	131.25
5BB1224	KVA	86.10	75.62	85.17	166.44	91.15	174.01	95.11	181.57	79.26	158.50	165.69	82.83	172.87	86.39	90.16	180.44
5.00 KVA	Load Amps	104.00	104.00	104.00	208.00	104.00	208.00	104.00	208.00	114.40	218.40	218.40	114.40	218.40	114.40	114.40	218.40
Quantity Required		**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
Connection Diagram		**E**	**G**	**G**	**H**	**G**	**H**	**G**	**H**	**G**	**H**	**H**	**G**	**H**	**G**	**G**	**H**

*Output voltage for lower input voltage can be found by: $\frac{\text{Rated Output Voltage}}{\text{Rated Input Voltage}}$ x Input Actual Voltage = Output New Voltage.

Buck-Boost Connection Diagrams

Single Phase

Diagram A

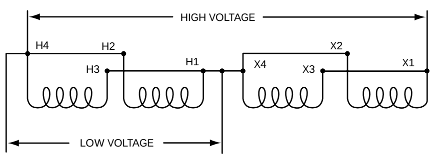


Diagram B

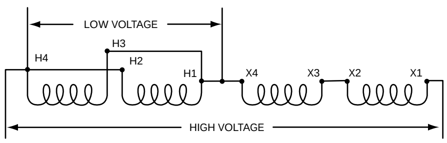


Diagram C

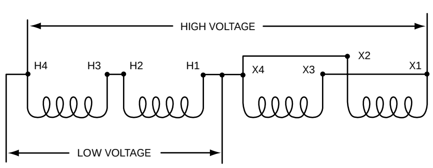


Diagram D

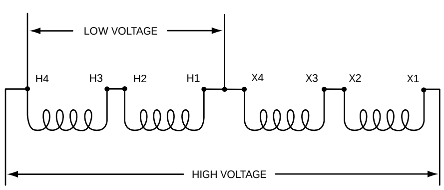
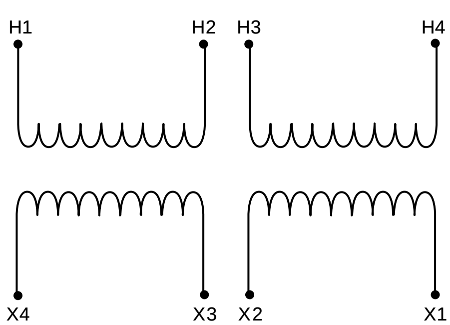


Diagram #1
(Standard Step-down application)



Three Phase

Diagram E ①

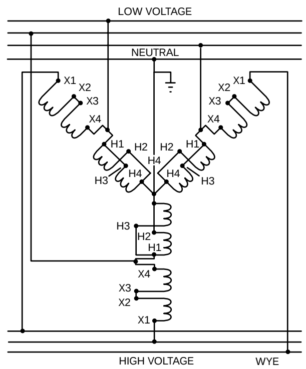


Diagram F ①

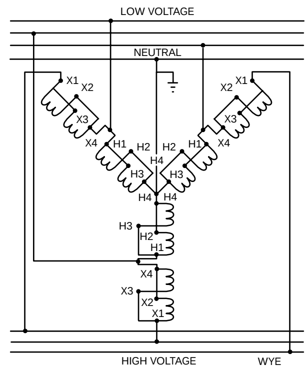


Diagram G

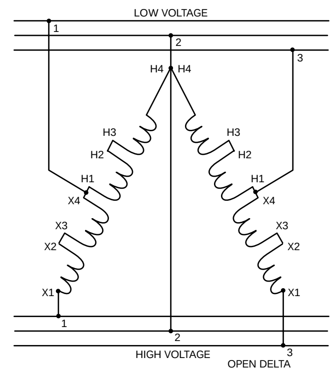


Diagram J ①

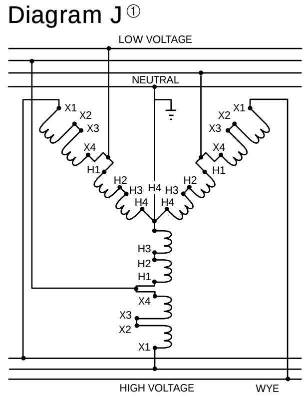


Diagram H

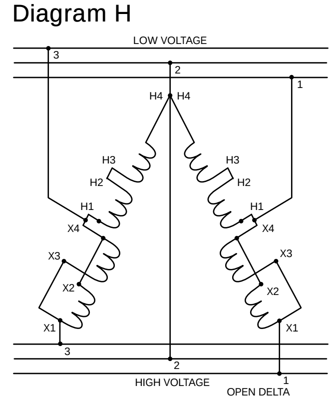


Diagram K ①

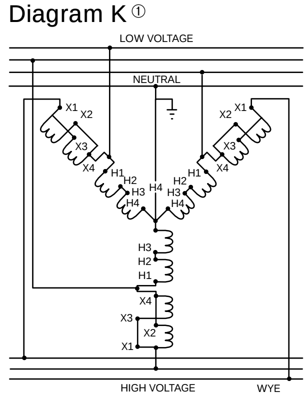
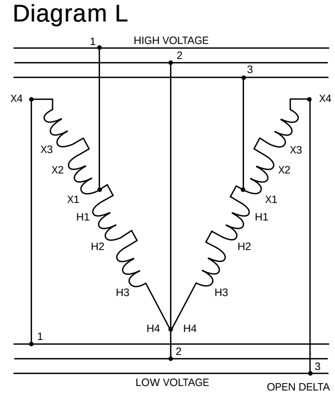


Diagram L



① The neutral XO should not be used when the source is a three wire supply.

NOTES
- Inputs and Outputs may be reversed: KVA capacity remains constant. All applications are suitable for 60Hz only.
- Refer to NEC 450-4 for overcurrent protection of an autotransformer.

Industrial Control Circuit Transformer

Features

1. Epoxy-encapsulated (50-750 VA) epoxy resin impregnated (1.0 - 5.0 KVA). Completely seals the transformer coils against moisture, dust, dirt and industrial contaminants for maximum protection in hostile and industrial environments.
2. Fuse clips (most models). Factory-mounted for integral fusing on the secondary side to save panel space, save wiring time and save the space, save wiring time and save the cost of buying an add-on fuse block.
3. Integrally-molded barriers. Between terminals and between terminals and transformer protect against electrical creepage. Up to 30% greater terminal contact area permits low-loss connections. Extra-deep barriers reduce the chance of shorts from frayed leads or careless wiring.
4. Terminals. Molded into the transformer and virtually impossible to break during wiring. A full quarter-inch of thread on the 10-32 terminal screws prevents stripping and pullout.
5. Ten year warranty At no additional cost.
6. Jumpers supplied. Two jumpers links are standard with all transformers which can be jumpered.

Operation

Industrial control circuits and motor control loads typically require more current when they are initially energized than under normal operating conditions. This period of high current demand, referred to as inrush, may be as great as ten times the current required under steady state (normal) operating conditions, and can last up to 40 milliseconds. A transformer in a circuit subject to inrush will typically attempt to provide the load with the required current during the inrush period. However, it will be at the expense of the secondary voltage stability by allowing the voltage to the load to decrease as the current increases. This period of secondary voltage instability, resulting from increased inrush current, can be of such a magnitude that the transformer is unable to supply sufficient voltage to energize the load. The transformer must therefore by designed and constructed to accommodate the high inrush current, while maintaining secondary voltage stability.

According to NEMA standards, the secondary voltage should typically be at 85% of the rated voltage.

Industrial Control Circuit Transformers are specifically designed and built to provide adequate voltage to the load while accommodating the high current levels present at inrush. These transformers deliver excellent secondary voltage regulation and meet or exceed the standards established by NEMA, ANSI, IL and CSA. Their hearty construction and excellent electrical characteristics provide reliable operation of electromagnetic devices and trouble-free performance.

Selection Process

Selecting a transformer for industrial control circuit applications requires knowledge of the following terms:

Inrush VA is the product of load voltage (V) multiplied by the current (A) that is required during circuit start-up. It is calculated by adding the inrush VA requirements of all devices (contactors, timers, relays, pilot lights, solenoids, etc.), which will be energized together. Inrush VA requirements are best obtained from the component manufacturer.

Sealed VA is the product of load voltage (V) multiplied by the current (A) that is required to operate the circuit after initial start-up or under normal operating conditions. It is calculated by adding the sealed VA requirements of all electrical components of the circuit that will be energized at any given time. Sealed VA requirements are best obtained from the component manufacturer. Sealed VA is also referred to as steady state VA.

Primary Voltage is the voltage available from the electrical distribution system and its operational frequency, which is connected to the transformer supply voltage terminals.

Secondary Voltage is the voltage required for load operation which is connected to the transformer load voltage terminals.

Once the circuit variables have been determined, transformer selection is a simple 5-step process as follows:

1. Determine the Application Inrush VA by using the following industry accepted formula:

Application Inrush VA =

$$\sqrt{(\text{Inrush VA})^2 + (\text{Sealed VA})^2}$$

2. Refer to the Regulation Chart. If the primary voltage is basically stable and does not vary by more than 5% from nominal, the 90% secondary voltage column should be used. If the primary voltage carries between 5% and 10% of nominal, the 95% secondary voltage column should be used.
3. After determining the proper secondary voltage column, read down until a value equal to or greater than the Application Inrush VA is found. In no case should a figure less than the Application Inrush VA be used.
4. Read left to the Transformer VA Rating column to determine the proper transformer for this application. As a final check, make sure that the Transformer VA Rating is equal to or greater then the total sealed requirements. If not, select a transformer with a VA rating equal to or greater than the total sealed VA.
5. Refer to the following pages to determine the proper catalog number based on the transformer VA, and primary and secondary voltage requirements.

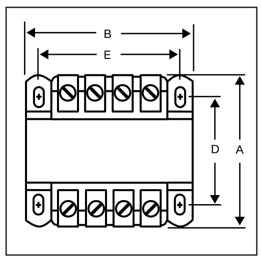
Regulation Chart

Transformer VA Rating	Inrush VA at 20% Power Factor		
	95% Secondary Voltage	90% Secondary Voltage	85% Secondary Voltage
25	100	130	150
50	170	200	240
75	310	410	540
100	370	540	730
150	780	930	1150
200	810	1150	1450
250	1400	1900	2300
300	1900	2700	3850
500	4000	5300	7000
750	8300	11000	14000
1000	9000	13000	18500
1500	10500	15000	20500
2000	17000	25500	34000
3000	24000	36000	47500
5000	55000	92500	115000

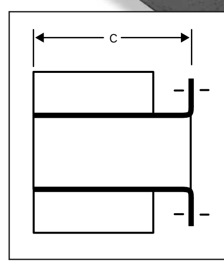
To comply with NEMA standards which require all magnetic devices to operate successfully at 85% of rated voltage, the 90% secondary voltage column is most often used in selecting a transformer.

Specifications

- Laminations are of the finest silicon steel to minimize core losses and to increase optimum performance and efficiency.
- Copper magnet wire of the highest quality assures efficient operation.
- Factory mounted type “K” fuse clips are standard on all single secondary transformers.
- Two jumper lines are standard with all transformers which can be jumpered.
- Optional type “M” fuse clips available for separate mounting.
- UL listed and CSA certified.
- 50/60 Hz rated.
- Insulation materials are of the highest rating available for the temperature class.
- Mounting brackets are heavy gauge steel to add strength to core construction and provide stable mounting. Slotted mounting feet permit easy installation.
- Attractive black finish: easy-to-read nameplate with complete rating data and wiring diagram.

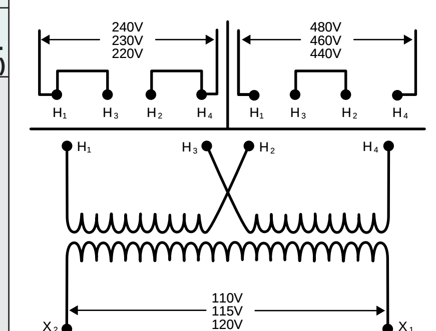


Top View



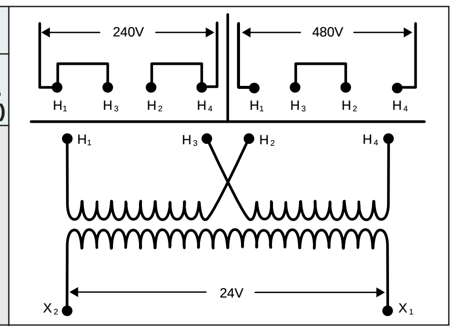
Side View

Primary Volts 240x 480, 230 x 460, 220 x 240				Secondary Volts 120/115/110					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	Output Ampere	“A”	“B”	“C”	“D”	“E”	Mounting Slots	Approx. Wt. (lbs)
MT0050A	50	55°C	0.43	3	3	2 9/16	2	2 ½	13/64 x ⅜	2.6
MT0075A	75	55°C	0.65	3 ½	3	2 9/16	2 ½	2 ½	13/64 x ⅜	3.5
MT0100A	100	55°C	0.87	3 ⅜	3 ⅜	2 ⅞	2 ⅜	2 13/16	13/64 x ⅜	4.2
MT0150A	150	55°C	1.30	4	3 ¾	3 3/16	2 ⅞	3 ⅛	13/64 x ⅜	6.7
MT0200A	200	55°C	1.74	4	4 ½	3 13/16	2 ½	3 ¾	13/64 x ⅜	8.5
MT0250A	250	55°C	2.17	4 ⅜	4 ½	3 13/16	2 ⅞	3 ¾	13/64 x ⅜	10.0
MT0300A	300	55°C	2.61	4 ¾	4 ½	3 13/16	3 ¼	3 ¾	13/64 x ⅜	11.3
MT0350A	350	55°C	3.04	5 ¼	4 ½	3 13/16	3 ¾	3 ¾	13/64 x ⅜	13.6
MT0500A	500	55°C	4.35	5 ½	5 ¼	4 ¾	4 ¼	4 ⅜	5/16 x 11/16	19.2
MT0750A	750	55°C	6.52	7	5 ¼	4 ¾	5 ¾	4 ⅜	5/16 x 11/16	28.1
MT1000A	1000	115°C	8.70	7 ⅞	5 ¼	4 7/16	5 ½	4 ⅜	9/32 x 13/32	29.8
MT1500A	1500	115°C	13.04	6 ¾	6 ¾	5 11/16	3 9/16	6 1/16	9/32 x 13/32	30.0
MT2000A	2000	115°C	17.39	7	6 ¾	5 11/16	4 7/16	6 1/16	9/32 x 13/32	38.0
MT3000A	3000	115°C	26.09	7 ½	9	7 9/16	4 ⅛	6 ½	7/16 x ¾	53.0
MT5000A	5000	115°C	43.48	7 ¾	9	7 9/16	6	6 ½	7/16 x ¾	89.0



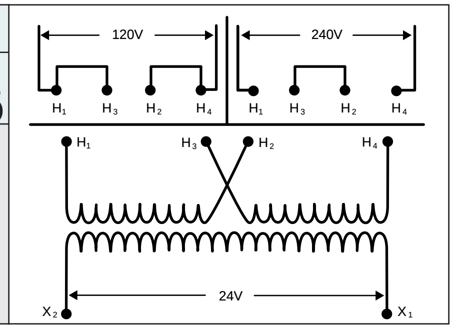
Includes secondary fuse clip on sizes 50 through 750VA.

Primary Volts 240x 480				Secondary Volts 24					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	Output Ampere	“A”	“B”	“C”	“D”	“E”	Mounting Slots	Approx. Wt. (lbs)
MT0050B	50	55°C	2.08	3	3	2 9/16	2	2 ½	13/64 x ⅜	2.7
MT0075B	75	55°C	3.13	3 ½	3	2 9/16	2 ½	2 ½	13/64 x ⅜	3.5
MT0100B	100	55°C	4.17	3 ⅜	3 ⅜	2 ⅞	2 ⅜	2 13/16	13/64 x ⅜	4.2
MT0150B	150	55°C	6.25	4	3 ¾	3 3/16	2 ⅞	3 ⅛	13/64 x ⅜	6.7
MT0200B	200	55°C	8.33	4	4 ½	3 13/16	2 ½	3 ¾	13/64 x ⅜	8.5
MT0250B	250	55°C	10.42	4 ⅜	4 ½	3 13/16	2 ⅞	3 ¾	13/64 x ⅜	10.1
MT0300B	300	55°C	12.50	4 ¾	4 ½	3 13/16	3 ¼	3 ¾	13/64 x ⅜	11.4
MT0350B	350	55°C	14.58	5 ¼	4 ½	3 13/16	3 ¾	3 ¾	13/64 x ⅜	13.4
MT0500B	500	55°C	20.83	5 ⅜	5 ¼	4 ¾	4 ⅛	4 ⅜	5/16 x 11/16	17.5



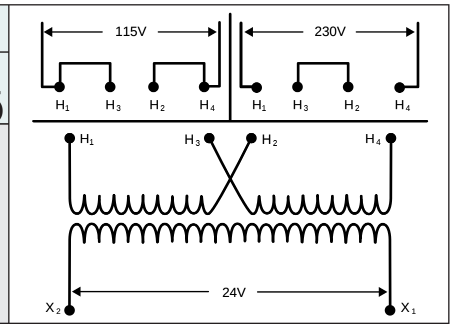
Includes secondary fuse clip on sizes 50 through 500VA.

Primary Volts 120x 240				Secondary Volts 24					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	Output Ampere	"A"	"B"	"C"	"D"	"E"	Mounting Slots	Approx. Wt. (lbs)
MT0050C	50	55°C	2.08	3	3	2 9/16	2	2 ½	13/64 x ⅜	2.6
MT0075C	75	55°C	3.13	3 ½	3	2 9/16	2 ½	2 ½	13/64 x ⅜	3.6
MT0100C	100	55°C	4.17	3 ⅜	3 ⅜	2 ⅞	2 ⅜	2 13/16	13/64 x ⅜	4.4
MT0150C	150	55°C	6.25	4	3 ¾	3 13/16	2 ⅞	3 ⅛	13/64 x ⅜	6.7
MT0200C	200	55°C	8.33	4	4 ½	3 13/16	2 ½	3 ¾	13/64 x ⅜	8.3
MT0250C	250	55°C	10.42	4 ⅜	4 ½	3 13/16	2 ⅞	3 ¾	13/64 x ⅜	10.1
MT0300C	300	55°C	12.50	4 ¾	4 ½	3 13/16	3 ¼	3 ¾	13/64 x ⅜	11.2
MT0350C	350	55°C	14.58	5 ¼	4 ½	3 13/16	3 ¾	3 ¾	13/64 x ⅜	13.2
MT0500C	500	55°C	20.83	5 ½	19 ⅕	4 ¾	4 ¼	4 ⅝	5/16 x 11/16	19.2



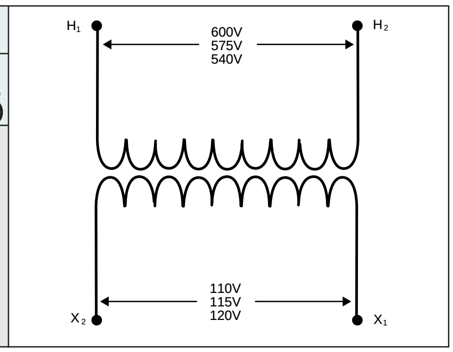
Includes secondary fuse clip on sizes 50 through 500VA.

Primary Volts 115x 230				Secondary Volts 24					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	Output Ampere	"A"	"B"	"C"	"D"	"E"	Mounting Slots	Approx. Wt. (lbs)
MT0050D	50	55°C	2.08	3	3	2 9/16	2	2 ½	13/64 x ⅜	2.7
MT0075D	75	55°C	3.13	3 ½	3	2 9/16	2 ½	2 ½	13/64 x ⅜	3.7
MT0100D	100	55°C	4.17	3 ⅜	3 ⅜	2 ⅞	2 ⅜	2 13/16	13/64 x ⅜	4.3
MT0150D	150	55°C	6.25	4	3 ¾	3 3/16	2 ⅞	3 ⅛	13/64 x ⅜	6.8
MT0200D	200	55°C	8.33	4	4 ½	3 13/16	2 ½	3 ¾	13/64 x ⅜	8.5
MT0250D	250	55°C	10.42	4 ⅜	4 ½	3 13/16	2 ⅞	3 ¾	13/64 x ⅜	10.1
MT0300D	300	55°C	12.50	4 ¾	4 ½	3 13/16	3 ¼	3 ¾	13/64 x ⅜	11.4
MT0350D	350	55°C	14.58	5 ¼	4 ½	3 13/16	3 ¾	3 ¾	13/64 x ⅜	13.4
MT0500D	500	55°C	20.83	5 ½	19 ⅕	4 ¾	4 ¼	4 ⅝	5/16 x 11/16	19.2



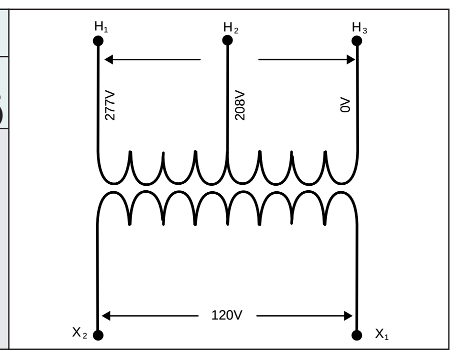
Includes secondary fuse clip on sizes 50 through 500VA.

Primary Volts 540/575/600				Secondary Volts 110/115/120					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	Output Ampere	"A"	"B"	"C"	"D"	"E"	Mounting Slots	Approx. Wt. (lbs)
MT0050E	50	55°C	0.43	3	3	2 9/16	2	2 ½	13/64 x ⅜	2.7
MT0075E	75	55°C	0.65	3 ½	3	2 9/16	2 ½	2 ½	13/64 x ⅜	3.6
MT0100E	100	55°C	0.87	3 ⅜	3 ⅜	2 ⅞	2 ⅜	2 13/16	13/64 x ⅜	4.2
MT0150E	150	55°C	1.30	4	3 ¾	3 3/16	2 ⅞	3 ⅛	13/64 x ⅜	6.8
MT0200E	200	55°C	1.74	4	4 ½	3 13/16	2 ½	3 ¾	13/64 x ⅜	8.4
MT0250E	250	55°C	2.17	4 ⅜	4 ½	3 13/16	2 ⅞	3 ¾	13/64 x ⅜	10.0
MT0300E	300	55°C	2.61	4 ¾	4 ½	3 13/16	3 ¼	3 ¾	13/64 x ⅜	11.3
MT0350E	350	55°C	3.04	5 ¼	4 ½	3 13/16	3 ¾	3 ¾	13/64 x ⅜	13.6
MT0500E	500	55°C	4.35	5 ⅜	5 ¼	4 ¾	4 ¼	4 ⅝	5/16 x 11/16	16.8
MT0750E	750	55°C	6.32	7	5 ¼	4 ¾	5 ¾	4 ⅝	5/16 x 11/16	25.7



Includes secondary fuse clip on sizes 50 through 750VA.

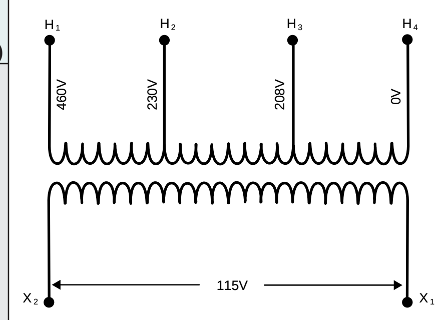
Primary Volts 208/277				Secondary Volts 120					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	Output Ampere	"A"	"B"	"C"	"D"	"E"	Mounting Slots	Approx. Wt. (lbs)
MT0050F	50	55°C	0.42	3	3	2 9/16	2	2 ½	13/64 x ⅜	2.9
MT0075F	75	55°C	0.63	3 ½	3	2 9/16	2 ½	2 ½	13/64 x ⅜	3.8
MT0100F	100	55°C	0.83	3 ⅜	3 ⅜	2 ⅞	2 ⅜	2 13/16	13/64 x ⅜	4.5
MT0150F	150	55°C	1.25	4	3 ¾	3 13/16	2 ⅞	3 ⅛	13/64 x ⅜	6.9
MT0200F	200	55°C	1.67	4	4 ½	3 13/16	2 ½	3 ¾	13/64 x ⅜	8.7
MT0250F	250	55°C	2.08	4 ⅜	4 ½	3 13/16	2 ⅞	3 ¾	13/64 x ⅜	10.2
MT0300F	300	55°C	2.50	4 ¾	4 ½	3 13/16	3 ¼	3 ¾	13/64 x ⅜	11.4
MT0350F	350	55°C	2.92	5 ¼	4 ½	3 13/16	3 ¾	3 ¾	13/64 x ⅜	13.7
MT0500F	500	55°C	4.17	5 ⅜	5 ¼	4 ¾	4 ⅛	4 ⅝	5/16 x 11/16	17.2
MT0750F	750	55°C	6.25	7	5 ¼	4 ¾	5 ¾	4 ⅝	5/16 x 11/16	25.7



Includes secondary fuse clip on sizes 50 through 750VA.

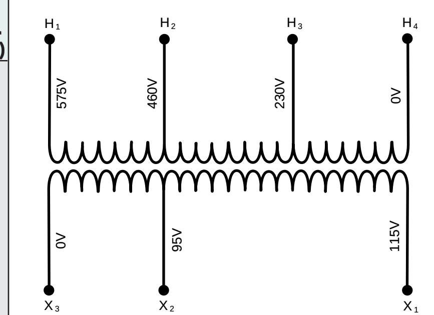
Specifications

Primary Volts 208/230/460				Secondary Volts 115					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	Output Amperes	"A"	"B"	"C"	"D"	"E"	Mounting Slots	Approx. Wt. (lbs)
MT0050G	50	55°C	0.43	3 1/8	3	2 9/16	2 1/8	2 1/2	13/64 x 3/8	2.8
MT0075G	75	55°C	0.65	3 3/8	3 3/8	2 7/8	2 3/8	2 13/16	13/64 x 3/8	4.3
MT0100G	100	55°C	0.87	3 11/16	3 3/8	2 7/8	2 11/16	2 13/16	13/64 x 3/8	4.9
MT0150G	150	55°C	1.30	4 3/16	3 3/4	3 3/16	3 1/16	3 1/8	13/64 x 3/8	7.4
MT0200G	200	55°C	1.74	4 1/4	4 1/2	3 13/16	2 3/4	3 3/4	13/64 x 3/8	9.4
MT0250G	250	55°C	2.17	4 3/4	4 1/2	3 13/16	3 1/4	3 3/4	13/64 x 3/8	11.1
MT0300G	300	55°C	2.61	5 1/4	4 1/2	3 13/16	3 3/4	3 3/4	13/64 x 3/8	13.6
MT0350G	350	55°C	3.04	5 7/8	4 1/2	3 13/16	4 3/8	3 3/4	13/64 x 3/8	15.6
MT0500G	500	55°C	4.35	6	5 1/4	4 3/4	4 3/4	4 3/8	5/16 x 11/16	21.0
MT0750G	750	55°C	6.52	7 3/8	5 1/4	4 3/4	5 3/4	4 3/8	5/16 x 11/16	30.0
MT1000G	1000	115°C	8.70	7 1/8	6 3/8	5 3/8	4 1/2	5 5/16	5/16 x 11/16	29.2
MT1500G	1500	115°C	13.04	7 1/2	6 3/4	5 11/16	4 7/16	6 1/16	9/32 x 9/16	33.5
MT2000G	2000	115°C	17.39	8 1/4	6 3/4	5 11/16	5 1/4	6 1/16	9/32 x 9/16	42.5
MT3000G	3000	115°C	26.09	8	9	7 9/16	4 5/8	6 1/2	7/16 x 3/4	63.7
MT5000G	5000	115°C	43.48	10 1/2	9	10 3/16	6 1/2	6 1/2	7/16 x 3/4	102.0



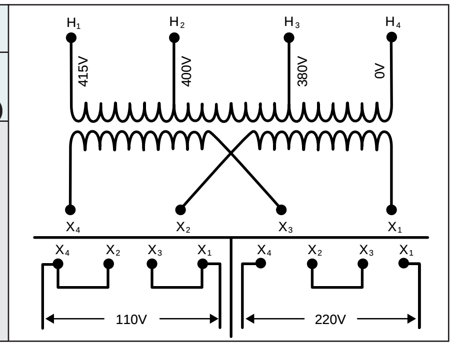
Includes secondary fuse clip on sizes 50 through 750VA.

Primary Volts 230/460/575				Secondary Volts 95/115					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	95/115 Output Amperes	"A"	"B"	"C"	"D"	"E"	Mounting Slots	Approx. Wt. (lbs)
MT0050H	50	55°C	.53/.44	3	3	2 9/16	2 3/16	2 1/2	13/64 x 3/8	3.5
MT0075H	75	55°C	.79/.65	3 3/8	3 3/8	2 7/8	2 3/8	2 13/16	13/64 x 3/8	4.5
MT0100H	100	55°C	1.05/.87	3 7/8	3 3/8	2 7/8	2 7/8	2 13/16	13/64 x 3/8	6.0
MT0150H	150	55°C	1.58/1.30	4 1/4	3 3/4	3 3/16	3 1/4	3 1/8	13/64 x 3/8	7.7
MT0200H	200	55°C	2.11/1.74	4 1/4	4 1/2	3 13/16	2 3/4	3 3/4	13/64 x 3/8	9.0
MT0250H	250	55°C	2.63/2.17	4 3/4	4 1/2	3 13/16	3 3/16	3 3/4	13/64 x 3/8	9.7
MT0300H	300	55°C	3.16/2.61	5 1/8	4 1/2	3 13/16	3 5/8	3 3/4	13/64 x 3/8	11.7
MT0350H	350	55°C	3.68/3.04	5	5 1/4	4 3/4	3 3/4	4 3/8	5/16 x 11/16	16.5
MT0500H	500	55°C	5.26/4.35	5 7/8	5 1/4	4 3/4	4 5/8	4 3/8	5/16 x 11/16	21.5
MT0750H	750	55°C	7.89/6.52	7	5 1/4	4 3/4	5 3/4	4 3/8	5/16 x 11/16	28.0
MT1000H	1000	115°C	10.53/8.70	7 1/8	6 3/8	5 3/8	4 1/2	5 5/16	5/16 x 11/16	29.2
MT1500H	1500	115°C	15.79/13.04	8 1/4	6 3/4	5 11/16	5 1/4	6 1/16	9/32 x 9/16	33.5
MT2000H	2000	115°C	21.05/17.39	7 9/16	9	7 9/16	4 9/16	6 1/2	7/16 x 3/4	42.5
MT3000H	3000	115°C	31.58/26.09	8 5/8	9	7 9/16	5 1/4	6 1/2	7/16 x 3/4	63.7
MT5000H	5000	115°C	52.63/43.48	13 1/2	9	10 13/16	8 1/4	6 1/2	7/16 x 3/4	102.0



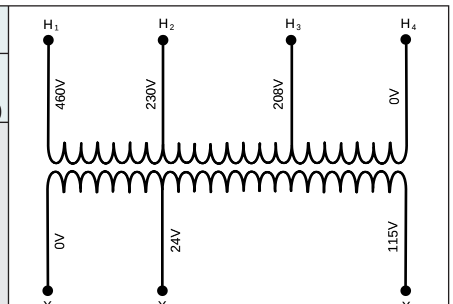
Does not include secondary fuse clip.

Primary Volts 380/400/415				Secondary Volts 110/220					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	110/220V Output Amperes	"A"	"B"	"C"	"D"	"E"	Mounting Slots	Approx. Wt. (lbs)
MT0050I	50	55°C	.455/.227	3	3	2 9/16	2	2 1/2	13/64 x 3/8	3.0
MT0075I	75	55°C	.68/.34	3 1/2	3	2 9/16	2 1/2	2 1/2	13/64 x 3/8	4.0
MT0100I	100	55°C	.91/.455	3 9/16	3 3/8	2 7/8	2 9/16	2 13/16	13/64 x 3/8	5.2
MT0150I	150	55°C	1.37/6.85	4	3 3/4	3 3/16	2 7/8	3 1/8	13/64 x 3/8	7.0
MT0200I	200	55°C	1.82/.91	4	4 1/2	3 13/16	2 1/2	3 3/4	13/64 x 3/8	8.7
MT0250I	250	55°C	2.28/1.14	4 3/8	4 1/2	3 13/16	2 7/8	3 3/4	13/64 x 3/8	10.2
MT0300I	300	55°C	2.72/1.36	4 3/4	4 1/2	3 13/16	3 1/4	3 3/4	13/64 x 3/8	11.0
MT0350I	350	55°C	3.18/1.59	5 1/4	4 1/2	3 13/16	3 3/4	3 3/4	13/64 x 3/8	13.0
MT0500I	500	55°C	4.55/2.27	5 3/8	5 1/4	4 3/4	4 1/8	4 3/8	5/16 x 11/16	20.0
MT0750I	750	55°C	6.82/3.41	7	5 1/4	4 3/4	5 3/4	4 3/8	5/16 x 11/16	28.0



Does not include secondary fuse clip.

Primary Volts 208/230/460				Secondary Volts 24/115					50/60Hz	
				Dimensions (inches)						
Catalog Number	VA Rating	Temp. Rise	24/115V Output Amperes	"A"	"B"	"C"	"D"	"E"	Mounting Slots	Approx. Wt. (lbs)
MT0050J	50	55°C	2.08/.44	3 1/4	3	2 9/16	2 1/2	2 1/4	13/64 x 3/8	3.4
MT0075J	75	55°C	3.13/.65	3 1/2	3 3/8	2 7/8	2 1/2	2 13/16	13/64 x 3/8	4.8
MT0100J	100	55°C	4.17/.87	3 5/8	3 3/4	3 3/16	2 1/2	3 1/8	13/64 x 3/8	5.9
MT0150J	150	55°C	6.51/1.30	4 3/8	3 3/4	3 3/16	3 1/4	3 1/8	13/64 x 3/8	7.9
MT0200J	200	55°C	8.33/1.74	4 1/2	4 1/2	3 13/16	3	3 3/4	13/64 x 3/8	10.6
MT0250J	250	55°C	10.42/2.17	5 1/4	4 1/2	3 13/16	3 3/4	3 3/4	13/64 x 3/8	13.9
MT0300J	300	55°C	12.50/2.61	5 1/8	5 1/4	4 3/4	3 7/8	4 3/8	5/16 x 11/16	15.5
MT0350J	350	55°C	14.58/3.04	5 3/8	5 1/4	4 3/4	4 1/8	4 3/8	5/16 x 11/16	16.8
MT0500J	500	55°C	20.84/4.35	6 1/2	5 1/4	4 3/4	5 1/4	4 3/8	5/16 x 11/16	23.4



Includes secondary fuse clip on sizes 50 through 500VA.

Glossary

Air Cooled
A transformer which uses air as the cooling method medium. Term is abbreviated with the ANSI designation AA indicating open, natural draft ventilated construction.

Ambient Noise Level
The inherent or existing noise level of the surrounding area measured in decibels.

Ambient Temperature
The inherent or existing temperature of surrounding atmosphere into which the heat of a transformer is dissipated. Transformers are designed for 30°C average ambient temperature with a 40° C maximum during any 24 hour period.

Ampere
A unit of electric current flow.

ANSI
American National Standards Institute, Inc.– a recognized organization which specifies the standards for transformers.

ASTM
American Society for Testing Materials.

ATC
Air Terminal Chamber. See Terminal Chamber.

Attenuation
A term used to denote a decrease in magnitude in transmission from one point to another. Typically expressed as a ratio or in decibels, as in electrical noise attenuation.

Autotransformer
A transformer with one winding per phase in which part of the winding is common to both the primary and the secondary circuits.

Banked
Two or more single phase transformers connected together to supply a three phase load.

BIL
Basic Impulse Level measures the ability of the insulation system to withstand high voltage surges.

Buck-Boost
Small KVA, two-winding transformers typically wired as an autotransformer to raise or lower single and three phase line voltages by 10 - 20%.

Cast Coil Transformer
Transformer with coils solidly case in epoxy resin under vacuum in a mold. Also called cast resin or epoxy cast coil transformer.

Center Tap
A reduced capacity tap at the midpoint in a winding. Also referred to as lighting tap.

Certified Test
Actual values taken during production testing which certify the values or results or testing to apply to a specific unit.

Coil
Turns of electrical grade wire or strip conductor material wound on a form; often referred to as winding.

Common Mode
Electrical noise or voltage disturbance that occurs between one of the line leads and the common ground, or between the ground plane and either the line or the neutral.

Compensated Transformer
A transformer with a turns ratio which provides a higher than rated voltage at no load and rated voltage at rated load. Such transformers cannot be used for reverse feed.

Conductor Losses
Losses in watts caused by the resistance of the transformer winding during a loaded condition. Also referred to as load loss or winding loss.

Continuous Rating
The constant load which a transformer can maintain indefinitely, at rated voltage and frequency, without exceeding its designed temperature rise.

Control Transformer
A transformer designed to provide good voltage regulation for control or instrumentation circuits having high inrush current or low power factor conditions.

Copper Loss
See load loss.

Core
Electrical grade steel laminations which carries the magnetic flux.

Core Loss
Losses in watts caused by magnetization of the core and its resistance to magnetic flux when excited or energized at rated voltage and frequency. Also referred to as excitation loss or no-load loss.

Current Transformer
Transformer generally used in control or instrumentation circuits for measuring current.

Decibel (dB)
A standard unit of measure of intensity.

Delta
A standard three phase connection with the ends of each phase winding connected in series to form a loop with each phase 120 degrees from each other. Also referred to as 3-wire.

Delta-Wye
A term or symbol indicating the primary connected in delta and the secondary in wye when pertaining to a three phase transformer or transformer bank.

Dielectric Tests
A series of tests conducted to verify effectiveness of insulation materials and clearances used between turns and layers in the winding.

Distribution Transformer
Generally referred to as any transformer rated 500 KVA and below, except for current, potential, or other specialty transformers.

Dry Type
A transformer without liquid for cooling.

Dual Winding
A winding consisting of two separate parts which can be connected in series or in parallel. Also referred to as dual voltage or series multiple winding.

Electrostatic Shield
Conductor material placed between the primary and secondary windings which is grounded to reduce electrical noise or line interference.

Exciting Current
"No-load current" flowing in the winding used to excite the transformer when all other windings are open--circuited. Usually expressed in percent of the rated current of a winding in which it is measured.

Encapsulated
Transformer with coils either encased or cast in an epoxy resin or other encapsulating materials.

FCAN
"Full Capacity Above Normal." A designation for no-load taps indicating the taps are suitable for full-rated KVA at the designated voltages above nominal voltage.

FCBN
Same as above except Full Capacity Below Normal.

Fan Cooled
Cooled mechanically to maintain rated temperature rise, typically using auxiliary fans to accelerate heat dissipation.

Flexible Connection
A non-rigid connection used to eliminate transmission of noise and vibration.

Frequency
Designates the number of times, or complete cycles, that polarity alternates from positive to negative per unit of time; as in 60 cycles per second. Also referred to as Hertz.

Full Capacity Tap
Tap than can deliver rated KVA without exceeding its designated temperature rise.

Grounding Transformer
A special 3 phase autotransformer used to establish a stable neutral point on a 3-wire delta system. Also referred to as Zig-Zag transformer.

Grounding
Connecting one side of a circuit to earth; or creating a conducting path to some conducting body that serves in place of earth through low-resistance or low-impedance paths.

Hertz (Hz)
A term for AC frequency in cycles per second.

High Voltage Winding
Designates the winding with the greater voltage; designated as HV on the nameplate and as H1, H2, etc. on the termination.

Hi Pot
High potential dielectric test impressed on the windings to check insulation materials and clearances.

Impulse Tests
Dielectric test which determines BIL capability by applying high frequency, steep wave-front voltage between windings and ground.

Impedance
Retarding or opposing forces of current flow in AC circuit, expressed in percentage.

Induced Potential Test
A high frequency dielectric test which verifies the integrity of insulating materials and electrical clearances between turns and layers of a winding.

Inductance
A property which opposes a change in current flow.

Inrush Current
Abnormally high current, caused by residual flux in the core, which is occasionally drawn when a transformer is energized.

Insulating Transformer
One which the primary winding connected to the input or source, is insulated from the secondary winding connected to the output or load. Also referred to as two-winding or isolation transformers, which isolate the primary circuit from the secondary circuit.

Iron Loss
See No Load Loss or Core loss.

IR%
Percent resistance. Voltage drop due to conductor resistance at rated current expressed in percent of rated voltage

IX%
Percent reactance. Voltage drop due to reactance at rated current expressed in percent of rated voltage.

IZ%
Percent impedance. Voltage drop due to impedance at rated current expressed in percent of rated voltage.

KVA
Kilovolt ampere rating with designates the capacity or output with a transformer can deliver at rated voltage and frequency without exceeding designed temperature rise. (1 KVA = 1000VA, or 1000 volt amperes).

Lamination
Thin sheets of special steel used to make the core of a transformer.

Liquid Transformer
A transformer which used mineral oil, or other dielectric fluid, which serves as an insulating and cooling medium.

Load Losses
Losses in watts which are the result of current flowing to the load. Also referred to as winding loss, copper loss, or conductor loss.

Mid-tap
A reduced capacity tap midway in a winding. Also referred to a Center tap; usually in the secondary winding.

NEC
National Electric Code.

NEMA
National Electrical Manufacturers Association.

No-load Loss
See core loss.

Oil Cooled
A transformer which uses oil as the cooling medium. Term is abbreviated with the ANSI designation OA indicating natural oil ambient ventilation.

Parallel Operation
Transformers having compatible design features with their appropriate terminals connected together.

Phase
Classification of an AC circuit; typically designated as single phase 2-wire or 3-wire, or three phase 3-wire or 4-wire.

Polarity
Designates the instantaneous direction of the voltages in the primary compared to the secondary.

Potential Transformer
A transformer generally used in instrumentation circuits for measuring or controlling voltage.

Power Factor
The relation of watts to volt amps in a circuit.

Primary Rating
The input, source, or supply side connected to the primary of the transformer in a circuit.

Rating
The design characteristics, such as primary and secondary voltage, KVA, capacity, temperature rise, frequency, etc.

Ratio
Refers to the turns ratio or the voltage ratio between the primary and secondary winding.

Reactance
The effect of inductive and capacitive components of a AC circuit producing other than unity power factor.

Reactor
A single winding device with an air or iron core which produces a specific amount of inductive reactance into a circuit, usually to reduce or control current.

Reduced Capacity Taps
Taps which are rated for winding current only (versus rated KVA), thus reducing available power because of lower output voltage.

Regulation
The percent change in secondary output voltage when the load changes from full load to no-load at a given power factor.

Scott Connection
A transformer connection generally used to get a two phase output from the secondary of a three phase input, or vice versa.

Sealed Transformer
An enclosed transformer completely sealed from the outside environment and usually contains pressurized inert gas.

Secondary Rating
The output, or load side connected to the secondary of the transformer in a circuit.

Series/Multiple
A winding consisting of two or more sections which can be connected for series operation or multiple (parallel) operation. Also referred to as dual voltage or series-parallel.

Star Connection
Same as wye connection.

Step-down Transformer
One in which the energy transfer is from the high voltage winding (primary input circuit) to the low voltage winding (secondary output or load circuit).

Step-up Transformer
The energy transfer is from the low voltage winding to the high voltage winding; with the low voltage winding connected to the power source (primary input circuit) and the high voltage connected to the load (secondary output circuit).

T-connection
Use of Scott connection for three phase operation using two primary (main) and two secondary (teaser) coils.

Tap
A connection brought out of winding at some point between its extremities to permit changing the nominal voltage ratio. Taps are usually located in the high voltage winding, typically expressed as FCAN and FCBN for no-load operation.

Temperature Rise
The increase over ambient temperature of the winding due to energizing and loading the transformer; typically measured as either average rise by resistance or as hot-spot.

Terminal Chamber
An enclosure with space for making connection to a substation transformer, typically used when the transformer is not direct connected or close coupled to another device.

Total Losses
The transformer electrical losses which include no-load losses (core loss) and load losses (winding losses).

Turns Ratio
See Ratio.

Transformer
A static electrical device which by electromagnetic induction transforms energy at one voltage or current to another at the same frequency.

Transformer Tests
Normal, routing production tests include: (1) core loss (excitation loss or non-load loss); (2) load loss – winding or copper loss; (3) Impedance; (4) Hi-pot – high voltage between windings and ground; (5) Induced – double induced two time normal voltage. Optional special tests include: (a) Heat Run – temperature testing; (b) Noise tests – sound level measurement (c) Impulse tests – BIL tests.

Transverse Mode
Electrical noise or voltage disturbance that occurs between phase and neutral, or from spurious signals across the metallic hot line and the neutral conductor.

UL
Underwriters Laboratories.

Voltage Ratio
See Ratio.

Voltage Regulation
The change in secondary voltage which occurs when the load is reduced from rated value to zero, with the values of all other qualities remaining unchanged. Regulation may be expressed in percent (per unit) on the basis or rated secondary voltage at full load.

Winding Losses
See Load Losses.

Wye Connection
A three phase connection with similar ends of each phase connected together at a common point which forms the electrical neutral point which is typically grounded.

Zig-Zag
Special transformer connection commonly used with grounding transformers. See also grounding transformers.